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Analysis of policy mixes to foster R&D investment and to contribute to the ERA

Romania

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(JRC- IPTS)

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Executive Summary

1. Characteristics of the national research system and assessment of recent policy changes

In terms of goal setting, Romania initially adopted the 3% Gross Expenditure on R&D (GERD) target (1% public and 2% private share) by 2013-2015. Nevertheless, given recent evolution in RDI expenditure and the economic crisis, this goal is less realistic. In 2007, total R&D expenditure reached ~0.53% of GDP, while public expenditures reached 0.35% in 2008.[1] The dynamics of business R&D investment are not positive, with only a slight increase from 0.14% in 2006 to 0.22 % in 2007, well below the target.

2009 developments: Romania's economy was highly vulnerable to the international financial crisis. The **2009 GBAORD commitment of €986m** (accounting to **0.86%** of GDP) (NRP, 2008) was cut to **€320m (0.27% of GDP),** the public funds for R&D decreasing by around 50% compared with 2008. The long-standing challenges of the national RDI system are underlined by very high uncertainty and volatility of all macro-economic national indicators for 2009 and the weak budget programming mechanism.

The Ministry of Education, Research and Innovation[2] (MERI) through the National Authority for Scientific Research (NASR) formulates R&D and innovation policies, monitors their implementation and assesses their results and impact. Public funds are primarily channelled through NASR, through a competition mechanism.

The National Research, Development and Innovation Strategy (NRDIS) 2007-2013 provides the main framework for the governance of Romanian S&T policy. With a multi-annual budget of RON15000m (~€4700m[3]) the National Plan for R&D and Innovation 2007-2013 (NPRDI 2) is the main implementation instrument of NRDIS. Since 2007, Romania has benefited from the Cohesion Fund (CF) and Structural Funds (SF), which amount to about €17.2b for the period 2007- 2013. The National Strategic Reference Framework (NSRF) maps out the national strategy for investing SF which are disbursed through Sectoral Operational Programmes (SOP). The Sectoral Operational Programme "Increase Of Economic Competitiveness" (SOP-IEC) through its second priority axis (PA2)[4] specifically targets RDI activities as means of economic growth. A budget of €647m (€536.4m community funding and €109.9m national counterpart) is dedicated to this axis.

The "National Pact for Education and Research", involving all responsible political and civic actors, was established in March 2008, to support the optimal development of the RDI and education systems, transcending political changes. A number of other strategic documents complement the R&D Strategy, including: SOP-Human Resources Development, the National Export Strategy, NRP, Energy Strategy of Romania for 2007-2020, Sectoral Programmes, National Research Infrastructures Roadmap. These all form part of an integrated RDI policy, which is the first strategy to attempt holistic approaches and to formulate visions based on a comprehensive analysis of the causes which generated Romania's weak economic competitiveness and low scores in international RDI rankings. The RDI strategy allows all R&D actors

[1] According to unofficial data, although the 2008 RDI budget has been kept in its committed values, it represents ~0.35% of GDP (compared to the committed value of 0.69%), due to the very high increase of GDP
[2] Previously (before December 2008) named Ministry of Education, Research and Youth (MERY)
[3] Exchange rate 3.21 as of 2007 reference time
[4] *"Increasing the Economic Competitiveness through Research-Development and Innovation"*

to access public funds; it promotes multi-annual funding and stimulates collaborative and multidisciplinary research. The measures implemented since 2004 have already had a positive impact on knowledge production, showing that the low scientific output was attributable mainly to the scarcity of R&D funds.

2. National policy mixes towards R&D investment goals

Romanian policy makers recognize, generally speaking, that R&D and innovation are the key drivers of the economic growth, with political consensus on the need for a comprehensive policy mix approach. The current **policy mix** is broadly relevant to the national challenges and can be seen as a result of premeditated coordination of policy strategies offering overall balanced support to the science base, inter-sectoral and international circulation of knowledge and business innovation. Several funding instruments, with budgets deriving from SF and the state budget are attached to the policy mix routes and are complemented by indirect measures such as tax incentives and better regulation of the business sector. Nevertheless, the effectiveness of the National R&D Strategy for 2007-2013 is difficult to assess at this stage, as its implementation is underway and has been seriously affected by the 2009 R&D budget cut. Given the 2-3 years lag required by the business R&D expenditures to react after the public push, some positive policy impact should be visible from 2012, if the implementation follows the projected path.

Despite the developments at policy level, the R&D system is still confronted with weaknesses regarding its performance and the governance of research activity. Foremost, the lack of long term consistency can seriously put the whole RDI system at risk. Although the public funds for RDI had steadily increased until 2008, efforts remain tentative if the assessment steps beyond the national landscape. In 2007, Romania was still ranked the second lowest, with a GERD to GDP ratio ~3.5 times lower than the EU average. This situation is underlined by the high level of funding required to rebuild the science base in Romania, after years of neglect. The 2009 significant budget cut jeopardises the benefits of the prior developments, compromising the long term implementation of the R&D strategy.

In 2007, GERD was performed in the following proportions: 41.6% by the private sector, 33.9% by the government sector and 24.1% by HEIs. The share of public research organizations (PROs) in the R&D expenditure is considerably higher than the EU average (13%) (INSSE data). With 800 public and private R&D organisations, many showing very low scientific output, the RDI system has remained fragmented and underperforming. The latest dominance of competition channelling mechanism, open to all R&D performers, was aimed at supporting scientific excellence. In this positive context, the HE sector, has increased its GERD share from 10.12% (2004) to 24% (2007) (INSSE, 2009) and has become the leader in terms of scientific output (Ad-Astra, 2006). Nevertheless, while the HE sector does not benefit from institutional funding for research, PROs still take advantage of block funding and various other schemes specifically targeting them. The 2009 budget law and drastic cut of the R&D budget has brought another negative aspect: while competitive funds have decreased considerably, the block funding distributed to the Romanian Academy has increased with ~31% compared to 2008 (NASR, 2009). Although the HE sector has shown strong revitalisation in terms of research, as an education provider, its quality has suffered. In order to comply with Bologna requirements, the education system has expanded geographically and has been restructured. However, this has not been achieved in a coherent and consistent manner (SAR, 2007). HEIs, especially private ones, have responded mainly to the immediate demand of the target population, without taking into consideration medium and long-

term economic evolutions. This has triggered the rapid and artificial increase of the number of public and especially private faculties, the later showing virtually zero scientific output (Ad-Astra, 2006).

Even if steps have been made to address the weaknesses of the public administration, the inefficiencies of the judiciary system and the limitations in access to public money, these remain important drawbacks. The design of ministries, agencies and policy mechanisms may make it difficult to implement RDI policy effectively. The lack of transparency and quality of evaluation as well as delays in respecting deadlines could compromise the strategic goals. Enterprises may remain reluctant to the policy push in favour of increased competitiveness through RDI, especially given the prevalence of traditional industrial sectors showing low knowledge demand.

Barriers to R&D investment	**Opportunities and Risks generated by the policy mix**
Economic crisis	Risk: High R&D expenditure targets have been set; yet the weak budgetary planning and execution, with frequent in-year rectifications accentuated by the world economic crisis can jeopardise the targets.
Low Private R&D expenditure. Low innovation culture. Lack of tradition of collaboration public-private in R&D activities	Opportunities: Set of direct measures, complemented by tax incentives are implemented to support R&D expenditure in innovative enterprise, to increase the R&D public- private collaboration. RISKS: Low technologies, showing a weak demand for knowledge Lack of response from the private sector, that may continue to hesitate to increase their competitiveness based on RDI activities
The national industry and FDI pattern	RISKS Privatisation-led FDI inflow is over. Unless other factors will trigger the FDI inflow, this will seriously decline in the next years. Weak demand for knowledge from industry. Lack of highly skilled labour force available due to inefficient reform of HE system and large migration
Weak public administration. Lack of awareness and transparency of public procurement. Inefficient judiciary system. Low business infrastructure.	Opportunities: Good strategy is mainly in place. RISKS Some progress has taken place, yet progress remains slow. The implementation is supported by a complex administrative system which has not been reformed, preserving unfavourable institutional habits.

European Research Area

The European dimension and the importance of international/European co-operation and partnerships is highly acknowledged in the national R&D strategy. Some measures have been implemented with the explicit aim to encourage and fund international R&D collaboration, to ssupport mobility, scientific performance and to encourage inward mobility, mainly from Romanian scientific Diaspora. In accordance with the recommendations included in the Road Map for the National Research Infrastructures the competition for large research infrastructures (RIs) was launched in 2008. Universities are enjoying the freedom to manage their research budget and to formulate their own research agendas. Nevertheless, while the overall evolution in 2008 is positive, the assessment of the implementation shows that a more systemic and coherent approach is necessary in order to make the objectives attainable. The recent efforts aimed to attract young researchers to scientific career, unless supported by consistent provisions for the long term academic and research careers will not achieve significant results. An outdated legal framework and firmly established human resources practices still hinder or prevent international competition-based recruitment in the public sector. Although, The National Strategy 'Education and Research for a society of Knowledge' and the proposal of the Law of

Higher Education if implemented, may respond to many deficiencies that preclude the labour market for research attaining a real European dimension, the overall national context in terms of research conditions and quality of life, make it difficult for universities and PROs to compete in an international research market, many nationals choosing the more favourable framework conditions available abroad.

	Short assessment of its importance in the ERA policy mix	**Key characteristics of policies**
Labour markets for research	Important at policy level, but implementation lacks coherent and systemic approach	▪ Measures were taken to support mobility, reward scientific performance and attract young graduates into research careers. ▪ The labour market for researchers remains unattractive to foreigners, many nationals choosing options available abroad. ▪ Outdated legal frame and well established human resources practices still hinder or prevent international competition-based recruitment in the public sector. ▪ Sometimes measures were taken in isolation: increase of public PhD stipends led to the situation in which these are higher than public wages for well established academic & researchers holding a PhD.
Governing RIs	Important	▪ First call for large RIs was launched in 2008. The National Roadmap is complementary to ESFRI
Autonomy of research institutions	Increasingly important	▪ The legal frame established by active relevant laws guarantees the academic autonomy, but also defines its boundary. There is little freedom in designing human resources policies in terms of hiring, progression, payment and number of teaching hours.
Opening up of national research programmes	Increasingly important	▪ Strongly national with regards the main applicant, yet no nationality restrictions are ruled for the composition of the research teams ▪ Several measures support participation in bilateral agreements, ERA-nets, JTIs and FP7

On a policy level, NRDIS 2007-2013 represents the first integrated vision regarding the national RDI system and long term priorities. Although the national RDI system still faces weaknesses related to implementation disturbances, complex institutional landscape, fragmented R&D system, the strategy provides a good basis for restructuring and improvement. While the positive evolution of R&D expenditure in 2007 and 2008 raised hopes for a potential improvement, the substantial 2009 R&D budget cut could generate a serious decline in the R&D base. Foremost it may lead to the loss of hope in a positive evolution of the R&D national landscape and will deepen the mistrust in the political engagements. As the younger researchers are most likely to be affected in terms of employment opportunities, Romania may face a new dramatic brain migration, while losing in the future the grounds for attracting the Romanian Diaspora. While hopes are that the RDI budget will be increased due to the international loan package, all the RDI stakeholders have raised the awareness that the "*damage has already been done*". In the context of the world economic crisis and recent governmental reshuffle, while most of the European countries respond to the crisis by increasing the R&D budget, in the turmoil of still many ongoing changes, it is questionable, yet premature to answer, if the serious R&D budget decrease is a deliberate political choice or a prerequisite triggered by the international economic context and accumulated imbalances generated by the overheating national economy. In this vein, it remains open for assessment if the RDI strategy and the R&D expenditure targets will remain only another political rhetoric. Although, all the political parties made firm promises regarding their support to RDI and education, the 2009 budget law showed that the RDI system remains too sensitive to the political and economic context, regardless consistent and systemic political commitments.

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1 Introduction

As highlighted by the Lisbon Strategy, knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are at the heart of the Lisbon Strategy. The strategy reflects this in guideline No. 7 of the Integrated Guidelines for Growth and Jobs. This aims to increase and improve investment in research and development (R&D), with a particular focus on the private sector.

One task within ERAWATCH is to produce analytical country reports to support the mutual learning process and the monitoring of Member States' efforts in the context of the Lisbon Strategy and the ambition to develop the European Research Area. The first series of these reports was produced in 2008 and focused on characterising and assessing the performance of national research systems and related policies in a comparable manner.

This report is based on a synthesis of information from the European Commission's ERAWATCH Research Inventory[5], the ERAWATCH Analytical Country Reports 2008 and other important publicly available information sources.

Chapter 2 give an analytical overview of structural and performance characteristics of the national research system and of recent policy changes addressing the identified research system weaknesses in four policy-related domains. Furthermore, the main policy-related opportunities and risks related to the four domains are analysed and assessed. The following chapters focus on two main elements of national policy mixes. Chapter 3 analyses and assesses the evolution of national policy mixes towards Lisbon R&D investment goals. Chapter 4 deals with the contribution of national policy mixes to the realisation of the European Research Area. Chapter 5 concludes. A brief annex (not to be published) contains an expert appraisal of the results in relation to the 2008 Commission assessment of Lisbon strategy implementation.

2 Characteristics of the national research system and assessment of recent policy changes

2.1 Structure of the national research system and its governance

Romania is the largest country in southeastern Europe and the twelfth-largest in Europe and has a population of 21698181 inhabitants.[6] According to the latest available data, Romania ranks the lowest among EU countries in terms of R&D personnel relative to the total employment (0.45%) and second the lowest in terms of R&D expenditure as % of GDP and euro per inhabitant (€30.3 compared to the EU 27 average of €456.7) (EUROSTAT, 2008).

At the legislative level, two commissions: the Senate Commission for Education, Science and Youth and the Chamber of Deputies Commission for Education, Science, Youth and Sport have the role to debate and approve draft laws and other legislative documents related to science, education, sport and youth.

A National Council for Science and Technology (S&T) Policy was founded in 2002[7] to function as the government's high-level policy coordination body. Its main mission is to establish the priorities and legislative framework for the implementation of the

[5] ERAWATCH is a cooperative undertaking between DG Research and DG Joint Research Centre and is implemented by the IPTS. The ERAWATCH Research Inventory is accessible at http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.home. Other sources are explicitly referenced.
[6] According to the 2002 census
[7] Governmental Order no. 57/2002

National Strategy for Research, Development and Innovation (NSRDI), in line with the objectives and sectoral strategies of the government programme and in consultation with key stakeholders. The Ministry of Education, Research and Innovation[8] (MERI) through the National Authority for Scientific Research (NASR) formulates R&D and innovation policies, monitors their implementation and assesses the results and impact. MERI collaborates with 10 other ministries involved in RDI activities and is supported in undertaking its attributions by experts and consultative councils.[9] Professional representatives and private associations are invited to join several consultative bodies, such as the Advisory Board for Research, Development and Innovation (RDI), Trilateral Commission for Social Dialogue.

The following bodies operate at present, under the coordination of the NASR, as *agencies* for the implementation and financing of national programmes:

- The Executive Unit for Financing Research in Universities (EUFRU), through the National University Research Council (NURC) is the main funding agency for university and postgraduate research programmes targeting the development of scientific careers and increasing research capacity in universities. It functions as an interface between the university research community and MERI.
- The National Centre for Programme Management (NCPM) manages a number of the R&D programmes coordinated by NASR. It also functions as a funding agency under the ERA-NET Scheme (FP6 and FP7), Art. 169 and Joint Technology Initiatives.
- The Managerial Agency for Scientific Research, Innovation and Technology Transfer (MASRITT) from the Polytechnic University in Bucharest will perform this coordination role until the formation of Innovation Council, which was scheduled for 2008 (to date not achieved).
- Institute of Atomic Physics (IFA) is responsible for FP7- EUROATOM projects.
  Currently, all these coordinating bodies are adjusting their information systems to the legal requirement for a single reporting structure.[10]

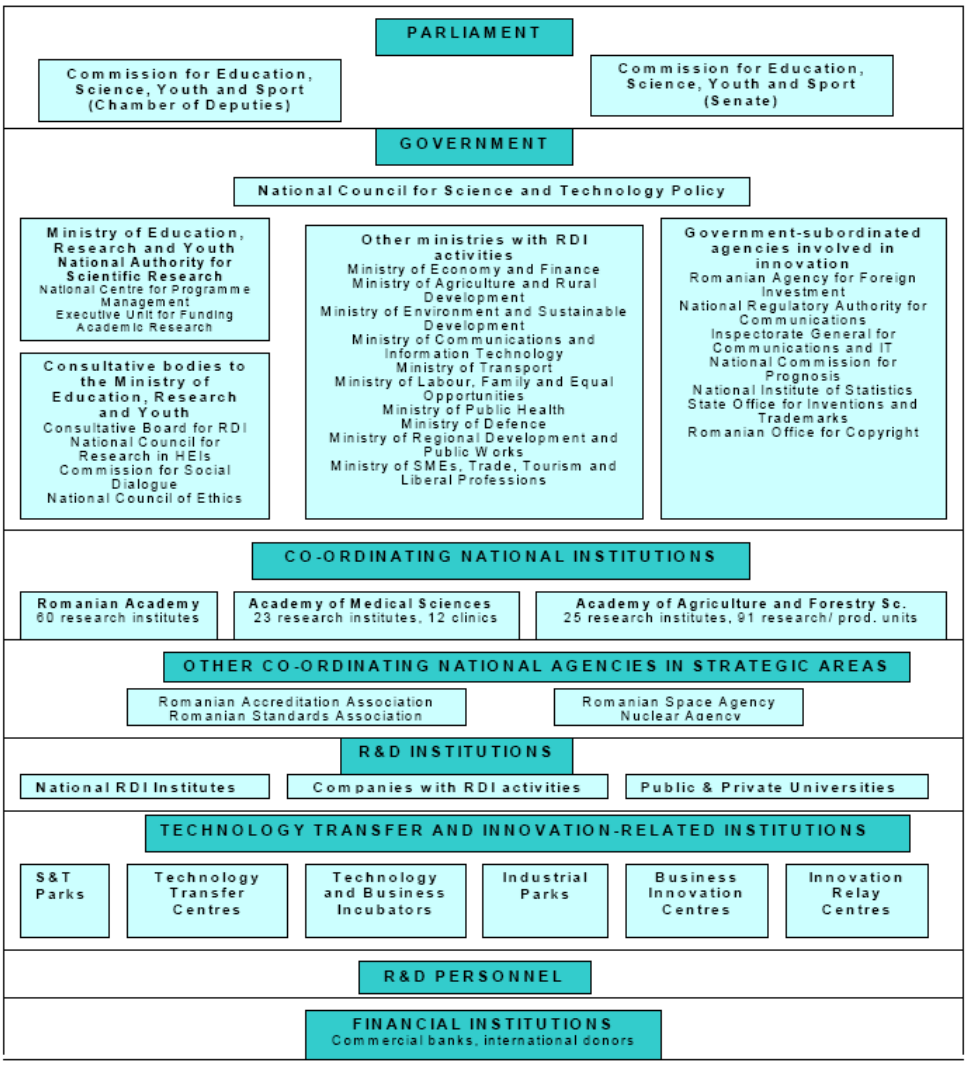
In April 2007, NASR established the Romanian Committee for Research Infrastructure (RCRI)[11] as a strategic forum having the responsibility to formulate a unitary strategy for the development of the national R&D infrastructure.

In 2006, the Romanian Office for Science and Technology (ROST) became operational in Brussels, having the main role to support the participation of the Romanian research community in the EU R&D programmes.

Four consultative bodies to NASR set the sectoral priorities and decide on funding allocation under the framework programmes (FP) of the National Plan for RDI. These are: (1) Consultative *Board for RDI,* which represents the S&T community and the socio-economic environment**;** (2) NURC, organised in seven commissions with different S&T specialisations, including representatives of the academic research community; (3) *The Commission for Social Dialogue,* which provides the institutional framework for consultation with the social partners and includes representatives of the ministry, unions and employers' associations; and (4) *The National Council for*

[8] Previously (before December 2008) named Ministry of Education, Research and Youth (MERY)
[9] The National Council for Reform in Education, National Council for the Recognition of Diplomas (NCRED), National Council for Funding the Higher Education, The National University Research Council (NURC), The National Council of Libraries, The National Council of Rectors, National Council for Funding the pre-university Education.
[10] On the basis of ANCS President's Decision no 9713/2008, which establishes a single reporting structure for all NPRDI 2 programmes
[11] With 9 members (5 representatives of the scientific community and 4 from funding agencies)

Ethics, which is organised in three permanent commissions: Socio-Humanities Sciences, Life Sciences and Exact and Technical Sciences.



Source: ERAWATCH Research Inventory, Romania

Figure 1: The Structure of the Romanian RDI system

Four National Agencies provide coordination mechanisms in strategic areas. The *Romanian Standards Association (ASRO),* in charge of developing national standardisation and quality certification and *Romanian Association for Accreditation (RENAR)* are accountable for accreditation to the National Quality System. The other two agencies coordinate R&D activity in their respective fields: the National Agency for Atomic Energy promotes development in the nuclear field and co-ordinates scientific research and co-operation with international organizations; and the Romanian Space Agency (ROSA) which is the national coordinating body of the space activities and the National Space R&D programme.

At national level there are *four academies (as below described)* that coordinate research in a network of institutes, being also involved in the formulation of R&D policies and strategic decision making.

In the innovation field, the initiatives to stimulate entrepreneurship and create a business environment favourable for the growth of start-ups and small medium

enterprises (SMEs), are under the responsibility of the Ministry of Economy and Commerce[12] and the National Agency for Small and Medium Enterprises and Co-operatives (NASMEC). The Ministry of European Integration and the eight Regional Development Agencies (RDA) have the responsibility for schemes such as the Romanian Network for Innovation and Technological Transfer, and the Ministry of Public Administration and Home Affairs has the responsibility for the Industrial and Software Parks Programme. The Ministry for Information and Communications Technology (since December 2008 renamed as Ministry of Communication and Information Society) is the main authority of designing and implementing measures to stimulate the growth of the ICT sector.

Main performers

In 2007, GERD (accounting to 0.53% of GDP) was performed in proportion of 41.6% by the private sector, 33.9% by the public research organizations (PROs) and 24.1% by higher education institutions (HEIs). The PROs share in terms of R&D execution is considerably higher than the EU average (13%). A general revitalisation of research in HEIs has been observed since implementation of NSRDI 2, when funding through competitions open to all R&D actors became dominant. In this context, the GERD share of HE increased from 10.12 to 24% between 2004 and 2007 (INSSE data).

The structure of the RDI system is established by government order 57/2002.[13] There are currently over 800 R&D public and private organisations. The public sector includes 263 R&D facilities and institutions: 45 National R&D Institutes coordinated by eight ministries; 56 accredited public universities; 96 public institutes and organisations with RD main activity.

The Romanian Academy is organised into 14 scientific divisions and has its own national network of 66 research institutes and centres. In addition to the Romanian Academy there are three branch academies: the Academy of Medical Sciences (with 23 institutes and research centres and 12 clinics affiliated to medical universities) and the Academy of Agriculture and Forestry Sciences (with a network of 25 institutes and research centres, 91 research and production units). The Romanian Academy of Technical Sciences is aimed to promote the development and innovation in technological education and research.

Most R&D organisations are active in technical and engineering sciences. Around 44% of total personnel is active in the field of natural sciences and technical and engineering sciences, which could be a potential advantage for responding to research demand coming from the economic environment (NASR, 2007).

Another structural element of the RDI system is the "*The National Network of Technological and Innovation Transfer"* (ReNITT) which consists of 46 specific entities (technological transfer and information centres, technological and business incubators) as well as 4 scientific and technological parks located in different regions of the country. Among the important private research centres should be named the research group “Renault Technology Romania.” (NASR, 2007)

Government resolution (551/2007) establishes the legal frame that requires periodic accreditation of all RDI public or private organisations. Depending on the outcome of the evaluation, the organisations can be certified as having the capacity to carry out R&D activities financed with public funds. This resolution was aimed to ensure the

[12] Recently renamed The Ministry of SMEs, Commerce and Business Environment
[13] Approved by law 324/2003

minimum scientific quality standard (in terms of number of qualified researchers, access to RIs, scientific performance etc) for RDI organisations entitled to receive public funds allotted through various national Programmes.

The institutional role of the regions in research governance

Romania's regional governance system is based on eight development regions[14], which represent territorial units without administrative status. Individual development policies are formulated and implemented for each region.[15] However, the national government is the major source of funding RIs and knowledge creation, hence, there are limited regional RDI governance autonomy and policy competencies. Regional innovation is promoted primarily through the Regional Innovation Strategies (RIS) coordinated by the Regional Development Agencies. The Regional Operational Programme 2007-2013[16], the main instrument for regional development, through its *Priority Axis (PA) 4,"Consolidation of the regional and local business environment"* can be considered to include innovation objectives since provides funding for regional business support infrastructures, SMEs and entrepreneurial initiatives. (InnoPolicy-Trendchart 2008) Strong regional disparities between the capital region and the other regions exist in terms of distribution of R&D units, expenditures and personnel, business and innovation support infrastructure, with the highest concentrations of resources in the capital region Bucharest-Ilfov. This concentrates ~51 % of R& D personal, 60.6% of total FDI and 22.7% innovative enterprises.[17]

2.2 Summary of strengths and weaknesses of the research system

The analysis in this section is based on the ERAWATCH Analytical Country Reports 2008 which characterised and assessed the performance of the national research systems. In order to do so, the system analysis focused on key processes relevant for system performance. Four policy-relevant domains of the research system have been distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The analysis within each domain has been guided by a set of generic "challenges", common to all research systems, which reflect possible bottlenecks, system failures and market failures a research system has to cope with. The Analytical Country Report for the specific country can be found in the ERAWATCH web site.

Several strategic policy documents, acting as a framework for the governance of the Romanian S&T policy have been formulated since 2007. Many of the implementation instruments became operational in 2008 and early 2009, while others will be launched in 2009. The strategic documents detailed below were only marginally addressed in ERAWATCH Country Report 2008 (Sandu et al, 2008) and all the instruments active under the new RDI strategy can be regarded as recent progress in RDI system.

In order to promote the development of RDI activities in public and private R&D units, in 2007, the Government of Romania adopted the National Research, Development and Innovation Strategy (NRDIS) 200-2013. This is the first strategy elaborated through national level consultation of the majority of stakeholders in the RDI field.

[14] The eight regional development zones are coordinated at the national level by the National Council for Regional Development and at the regional level by individual Regional Development Councils and Agencies.
[15] The regional governance system was initially defined in Law 151/1998, later on replaced by Law 315/2004, which specifies the regional governance structures, coordination mechanisms, objectives, competences and specific instruments for the promotion of a regional development policy
[16] The Programme is managed by the Ministry of Development, Public Works and Housing
[17] REGIONAL INNOVATION STRATEGY OF BUCHAREST-ILFOV

The National Plan for R&D and Innovation 2007-2013 (NPRDI 2)[18] is the main instrument supporting the attainment of the specific objectives formulated by the 2007-2013 National R& Strategy, as listed below.

1. Increasing scientific performance

Goals: increased number of patents and articles in mainstream publications and increased share of innovative enterprises.

Targeted challenge: Modest national research output and the lack of interest towards the protection of intellectual property.

2. Development of system resources

Goals: Human resources: three fold increase of the number of researchers and gradual decrease of the researchers' age by 2013; provision of an average annual number of 2000 doctoral scholarships; increasing the attractiveness of research careers in Romania for both nationals and foreigners.

Research Infrastructures: Increased access to performance research infrastructures (RI), participation to large international/inter-governmental RI, development of large national research facilities of international interest.

Targeted challenge:

(1) Drastic decrease of the number of researchers from 1990 to 2004, underlined by the increase of scientists' average age; substantial brain drain and migration to more attractive national sectors.

(2) The low funding level had a negative impact on the maintenance and development of the RIs needed for advanced research.

3. Involvement of the private sector.

Goals: The increase of private R&D expenditure up to 1% of the GDP until 2013; development of public-private partnerships in science and technology (S&T) by establishing centres of competence, technology platforms, scientific parks and specialized interfaces between the RDI demand and supply; simplified access of innovative enterprises to the RDI financing schemes.

Targeted challenge:

(1) Low private R&D involvement. Business expenditure on R&D has declined during the last decade and the R&D content of FDI has remained low.

(2) Low Innovation culture: The lack of an R&D base in industry; the low to medium-tech sectoral composition is matched by low innovation performance.

4. Increasing the institutional capacity.

Goals: Reducing the RDI system fragmentation by fostering the cooperation and participation in national and international networks; transformation of the Romanian universities and public R&D institutes into actors on the international knowledge market; increase of their capacity to cooperate with the companies; international assessment of the research performance for all public actors, universities and public research institutes.

Targeted challenge: Fragmented research base; the lack of international assessment of research performance underlined by previously dominant institutional funding mechanism.

5. Expansion of international cooperation.

Goals. Expansion of international cooperation; A better representation of Romanian institutions and national RDI bodies at the European and international levels; Involvement of the Romanian scientific Diaspora.

Targeted challenge: The low funding and the lack of suitable research infrastructure disconnected Romania from the main European research goals.

Since accession to the EU in 2007, Romania has benefitted from the EU Cohesion Policy which is implemented with the help of the Cohesion Fund (CF) and the Structural Funds (SF), amounting to €17.2b for the period 2007- 2013. The National Strategic Reference Framework (NSRF), derived from the National Reform Programme 2007 – 2010 (NRP), is the most comprehensive national development strategy, mapping out the strategy for investing SF which are disbursed through Sectoral Operational Programmes (SOP), aimed at promoting sustainable growth. Potential beneficiaries can propose projects and apply for funding through the relevant SOP. Ex-ante evaluation was carried out for all OPs. The Sectoral

[18] Approved by Government Decision 475/ May 2007

Operational Programme "Increase Of Economic Competitiveness"(SOP- IEC) is one of the instruments under the convergence objective, which directly addresses the first priority of the NRP, *"increasing economic competitiveness and developing the knowledge-based economy*", while contributing to the implementation of all the other NRP priorities. Built on SWOT analysis of the entrepreneurship and innovation context, this development strategy defines the priority axes, key areas of intervention and proposed operations. Its second priority axis (PA 2) "Increasing the Economic Competitiveness through Research-Development and Innovation" specifically targets RDI as means of economic growth. SOP-IEC was elaborated under the coordination of the Managing Authority for SOP-IEC, active under Ministry of Economy and Commerce, while responsibility for each axis is implemented by a distinct authority. MERI, through NASR is the responsible authority for the implementation of the SOP-IEC PA2. During the period of implementation of the SOP-IEC three types of evaluation will be performed: two interim evaluations (one evaluation to be carried out at the end of 2009 and one in 2012), ad-hoc evaluations and evaluations with a cross-cutting theme. The ex-post evaluation shall be carried out by the Commission according to Art. 49 of the Council Regulation no 1083/2006.

In 2007, the Romanian Committee for Research Infrastructure (RCRI) delivered the "National Road map for RIs" which identifies the national high-priority RIs objectives and the associated financial efforts. The National Pact for Education and Research, involving all responsible political and civic forces, was established in March 2008. It has the purpose to support an efficient, optimum development of the RDI and education system, transcending the political changes and priorities. All the political parties made firm commitments regarding their support to RDI and education (in terms of finances: 1% public R&D expenditure and 6% of GDP for education). Other strategic documents complementing the R&D Strategy are the: Sectoral Operational Programme Human Resources Development (SOP-HRD), the National Export Strategy[19] and National Reform Programme.

The new funding instruments allow access to all R&D actors to public funds, promote multi-annual funding, stimulate collaborative and multidisciplinary research and co-funding from a variety of funding sources. Current policy documents such as the NDP, the NSRDI 2007-2013 and the NPRDI 2 have an overall emphasis similar to many of the main strands of EU policy in the research field.

Despite these positive developments at RDI policy level, the R&D system is still confronted with weaknesses regarding its performance and the governance of research activity. While the public financing system is gradually being transformed into a competitive one, the dynamics of business R&D funding is not positive. The contribution of the business sector to R&D remains low: 0.14% in 2006, 0.22 % in 2007 which is far from reaching the 2% Barcelona. Although supported by various programmes within SOP, the innovation and technology transfer (ITT) infrastructure, namely the organisations specialised in the dissemination, transfer and valorisation of R&D results is still in its early development stages.

[19] The National Export Strategy mentions the role of R&D in a section on "Bridging technology gaps", which calls for a more rapid development of the advanced technologies

Table 1: Summary assessment of strengths and weaknesses of the national research system

Domain	Challenge	Assessment of strengths and weaknesses
Resource mobilisation	Justifying resource provision for research activities	▪ *Strength:* Coherent RDI strategy and to a large extent mutually consistent RDI relevant documents, elaborated on SWOT analysis and public consultation
	Securing long term investment in research	*Strength* ▪ Significant increase of R&D public expenditures in 2007, 2008 ▪ Multi-annual commitments support long-term investment in research. ▪ The Pact for Education and Research signed by all responsible stakeholders ▪ Target of 1% of GERD/GDP was set *Weakness* ▪ The RDI commitments remain too sensitive to political and economic context. The drastic 2009 R&D budget cut will have long term consequences ▪ Business investment in R&D relative to GDP remains consistently low
	Dealing with barriers to private R&D investment	*Strength* ▪ Range of policies and instruments in place, supporting the collaboration between RDI actors and RDI activities in private enterprises (including spin-off and start-ups) *Weakness* ▪ Private R&D investment remains modest compared to EU standards and continue to decline. Business R&D is largely dependent on public funding ▪ Unfavourable structure of the industrial sector and FDI
	Providing qualified human resources	*Strength* ▪ Several Programmes support research for PhD and young post-doctoral researchers. *Weakness* ▪ Measures aimed to increase attractiveness of research careers were taken in isolation, targeting specifically the young researcher, without supporting consistently the long term research careers. ▪ As the younger researchers will be likely mostly affected by the 2009 R&D budget cut, Romania may face a new dramatic brain migration, while losing in the future the grounds for attracting the Romanian Diaspora
Knowledge demand	Identifying the drivers of knowledge demand	*Strength* ▪ Recent RDI policies have been designed by SWOT analysis and large public consultation. ▪ Many new programmes have been specifically designed to encourage the collaboration between public R&D performers and enterprises *Weakness* ▪ The slow pace of industry restructuring and development has a negative influence on the knowledge demand coming from the business sector.
	Co-ordination and channelling knowledge demands	*Strength* The coordination of knowledge demand is realised through NRSDI.
	Monitoring of demand fulfilment	Evaluations, SWOT analysis and public consultations were used for the development of national RDI strategy. Reports are openly published, and have become subject to extensive policy awareness and debate.
Knowledge production	Ensuring quality and excellence of knowledge production	*Strength* ▪ With NPRDI 2 the competitive funding has become dominant, acting as important tool to ensure excellence of knowledge production. Periodic monitoring and evaluation of the contracted projects. ▪ Strong competitions for funds between public R&D performers. ▪ Long tradition in some R&D fields

Domain	Challenge	Assessment of strengths and weaknesses
		Weakness ▪ The obsolete state of the national science base generated by the chronic low RDI funding after the collapse of communism. Extensive brain-drain and low quality of RIs. ▪ Low proportion of innovative enterprises
	Ensuring exploitability of knowledge	*Strength* ▪ NSRDI gives the premises for linkage between industry and public RDI organisations *Weakness* ▪ Low innovation culture. High heterogeneity across the country. ▪ Prevalence of traditional industrial sectors.
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	▪ A sound infrastructure to sustain knowledge circulation is in place. Several programmes extend support for joint R&D projects between university, public research units and the business sector. ▪ Lack of tradition of public-private collaboration in advanced science fields.
	Profiting from international knowledge	▪ Several programmes specifically support participation of national teams in inter-governmental RIs, international collaboration. ▪ Support for mobility of researchers has been extended. ▪ Measures have been taken to capitalise the knowledge input which can be gained from Romania Diaspora. ▪ Low inflow compared to outflow.
	Enhancing absorptive capacity of knowledge users	▪ Specific schemes target innovative enterprises. ▪ Regional knowledge diffusion remains weak in underdeveloped areas.

2.3 Analysis of recent policy changes since 2008

The contribution of research and research policies to Lisbon goals (as well as to other societal objectives) goes beyond the fostering of R&D investment. It is therefore important to also analyse how other remaining shortcomings or weaknesses of the research system are addressed by the research policy mix. The focus of the section is on the analysis of main recent policy changes which may have a relevant impact on the four policy-related domains.

2.3.1 Resource mobilisation

Since 2000, when Romania started negotiations for accession to the EU, the importance of R&D as a main driver for competitiveness and sustainability has been acknowledged and this gave an important push to the RDI system. The importance conferred by the government to RDI is reflected by the increasing trend (until 2008) of the total government budget allocated to public R&D expenditures (GBAORD). The share of GBAORD of total government expenditure has gradually increased from 0.47 % in 2003 to 0.96% in 2007.

The outlook regarding the growth of public funds for research, for the entire period 2007-2013, is the following: (1) Public national funds allocated for R&D: ~RON15b (~€4,5b); (2) EC Funds (FP7): ~ €700m; (3) Structural funds for infrastructure and R&D activities: around €600m. (NASR, 2007)

The NPRDI 2 approved by Government Decision 475/ May 2007 is the main instrument for the implementation of the 2007-2013 National RDI Strategy. With a multi-annual budget of RON15000m (€4700m[20]) the NPRDI 2 is structured in six main programmes:

1. Ideas (RON 2700m ~€841m[21] multi-annual budget, representing 18% of total NPRDI 2) programme, administrated by NURC is focused on fundamental research. This programme supports excellence and international visibility, interdisciplinary and leading

[20] Exchange rate 1 Euro = 3.21 RON as of 2007 reference time
[21] The figures represent the planned multi-annual budget, using the 2007 exchange rate of 3.21

edge research and participation in international networks regardless the research field, the finances being allotted on a competition base on topics identified in a bottom-up approach.

2. Human resources (RON1350m~ €421m, 9% of total NPRDI 2 funds), administrated by NURC, is aimed to increase the number of researchers, the attractiveness of scientific careers and improve R&D performance.
3. Capacities Programme (RON2025m ~ €631m, 13.5% of total NPRDI 2), coordinated by NASR through Module I and II supports the improvement of the R&D infrastructures, while modules III, IV support participation of Romanian teams in international collaboration, including inter-governmental RIs. Governmental funds allocated through NPRDI 2 are supplemented by SF dispersed through the operation Development of RIs and creation of new RIs.
4. Partnerships in priority S&T domains (RON 5400m ~ €1682m, ~ 36 % of NPRDI 2 funds), administrated by NCPM stimulates the collaboration between various RDI stakeholders within 9 thematic areas. "Increase of R&D capacity and stimulation of the cooperation between R&D institutions and enterprises" functioning under SOP-IEC (Priority Axis 2) support similar aims.
5. Innovation (RON2025m ~ €631m, 13.5% of NPRDI 2 funds), coordinated by MASRITT supports pre-competitive research projects and the development of innovation and is the main NPRDI 2 instrument directly targeting R&D activities in enterprises.
6. Sustaining the institutional performance (RON1500m~ €470m).

Allocation of resources to each programme is achieved on the basis of an ex-ante evaluation, monitoring and ex-post evaluation. In 2007 the funds allocated through NPRDI accounted to ~ RON 217m (~€67m), while in 2008 to ~ RON 929m (€289m). (NASR, 2007)

The EU contribution to the SOP-IEC is €2554m (~65.19% of the total budget), the rest being complemented by national funds. Around €647m (€536m community funding and €110m national counterpart) are dedicated to SOP-IEC PA2,"Increasing the Economic Competitiveness through Research-Development and Innovation". SOP-IEC which allocates funds for RDI activities on a competition basis. The PA 2 contains nine operations out of which four are designed for investment projects. Eight operations, with a total budget of RON 991m (approx. €233m[22]) were launched since 2008 to date and one ("Development of poles of scientific excellence") is currently under preparation in view of launch in 2010. The latest meeting of the SOP-IEC Monitoring Committee (Bucharest, October 2008) reported that about 40.55% of the total 2007-2013 budget of the programme was allocated so far.

The IMPACT programme (2006-2010) offers consultancy for the preparation of proposals submitted by national enterprises within SOP-IEC PA2 and had in 2008 a budget of ~€1.4m.

Research grants[23] (operational until 2008) gave a special attention to the correlation of the research programmes with the university and post-graduate training, aiming to support the development of scientific careers. In 2007-2008, a budget of ~RON 63m (€20.3m) was allocated to this programmes (NASR, 2007).

The Core R&D Programmes, complementing the National RDI Plan, were launched at the end of 2003 as programmes specifically targeting PROs and allocate via competitions public funds, up to the level of 60% of the R&D income realised by the applicant institution in the prior year. Through this programme RON137m (€43m)

[22] The exchange rate has been fluctuating. The average 2009 exchage rate 4.25 RON =1 Euro, as estimated by the National Commission of Prognosis, was considered

[23] The following categories of projects were promoted through this scheme: Multi-annual grants for scientific research; Multi-annual grants for young researchers; Individual research grants for young PhD students.

were disbursed in 2007 and ~ RON 190m (€59m) in 2008. In 2009, there are 46 active Core Programmes.

Programme Research of excellence (CEEX) operational in 2005-2008, played a significant role in the development of human capital and material base for RDI and dispersed in 2007-2008 through a competition mechanism ~ RON 1600m (~€500m).

"INFRATECH" Programme (2005-2008) had the aim to support the establishment and development of a national network of innovation and technological transfer. In 2007, RON 17m (€5.3m) were allocated for RDI activities.

The R&D sectoral plans, coordinated by the ministries responsible for the concerned sectors, support the R&D activities necessary to achieve the technological development objectives at the sector level. To be mentioned there are the sectoral plans launched in 2007 by the Ministry of Economy and Finance (MEF), the Ministry of Communications and Information Technology (MCIT) and MERI. The 2008-2010 budget estimated by MCIT for the R&D sectoral plan, counts to ~€10m, while MERI allocated ~€4.6m in 2008.

Complementary to these programmes targeting directly RDI activities is SOP-Human Resources Development (SOP-HRD). SOP-HRD PA1 "*Education and training in support for growth and development of knowledge based society*", promotes doctoral and post-doctoral programmes in support of research, while PA3 "*Increasing adaptability of workers and enterprises*" supports the development of entrepreneurial skills and training in new technologies.

Given the increase of the public RDI funds, monitoring and evaluation procedures have been set-up. For the programmes of NPRDI 2 the monitoring reports of the projects are issued by the implementation bodies on the basis of projects activity reports (intermediate/final) produced by the project consortium, as well as on the basis of the evaluation reports (intermediate/final) issued by independent evaluators. The SOP-IEC PA2 uses the same project monitoring and evaluation mechanisms. The overall concentration effect of the research potential is monitored in the framework of programme (half-yearly/yearly) monitoring and mid-term/final) evaluation process performed by the financing agencies (NRP 2008). Annual reports, analysing the implementation and impact of R&D programmes carried out by NASR are annually published on the NASR website.

Table 2: Main policy changes in the resource mobilisation domain

Challenges	Main Policy Changes
Justifying resource provision for research activities	• Many of the NPRDI 2 programmes became operational in 2008. • First calls within SOP-IEC PA2 were launched in 2008
Securing long term investments in research	• The Pact for Education and Research was signed by all responsible stakeholders; • The IMPACT Programme was launched under NPRDI 2 in order to support the absorption of Structural Funds.
Dealing with uncertain returns and other barriers	• The NRDIS contains provisions for the revival of private R&D; • Co-financing requirements under the NPRDI 2 are expected to stimulate the increase of the share of private funds for R&D. SOP-IEC PA2 operations are specifically designed to support RD activities in enterprises, innovative SMEs, start-ups and spin-off; • Support measures have been taken to improve the business environment and the access to public procurement.
Providing qualified human resources	• Several schemes under NPRDI 2 support PhD training and mobility; • SOP-DRU complements SOP-IEC and NPRDI in terms of human resources for R&D sector.

Changes in National Reform Programme regarding the role of research in the broader economic growth strategy

According to the Romania's NRP 2007-2010, the Government's long-term goals for the 2008-2010 cycle of the Lisbon Strategy are: (1) improving the administrative capacity, (2) Improving the quality and management of government expenditure, (3) Improving the functioning of markets (4) Improving the business environment (5) Increasing the employment and activity rates on the labour market. During 2008, the National Reform Programme (NRP) of Romania was revised and an Action Plan containing the additional measures taken by Romania in 2008 – 2009 was added to NRP.

The 2007-2013 National Research-Development and Innovation Strategy, adopted by the Romanian Government in March 2007 seeks to increase of the competitiveness of the Romanian economy through innovation. In order to support the achievement of the RDI strategy's objectives, Romania made a firm commitment to increase research public expenditure in 2007-2013. The public funds allocated for RDI reached at the end of 2007 the level of approximately 0.5% of GDP and about 0.7% of GDP in 2008. In 2009 the levels of 0.9%, respectively 1% in 2010 were committed. The strategy is implemented through the *2007-2013 RDI National Plan*, approved by the Government in May 2007. In order to stimulate the concentration of research potential and to reduce the fragmentation in the RDI system, R&D projects of high complexity, concentrating an important volume of human and material resources of high level, were promoted. Projects for large RIs were launched, being rated as a premiere for RDI system after 1990. The increase of enterprises competitiveness through R&D activities and development of their innovation capacity was supported especially by complex RDI projects (achieved both through the *Partnership in priority S/T fields* Programme, the Programme *Research of Excellence – CEEX* and by RDI projects initiated and managed directly by enterprises, in the framework of *Innovation* Programme of NPRDI 2. Romania is eligible for €19.67b Structural and Cohesion Funds in the period 2007-2013, out of which 56% are earmarked for Lisbon objectives. Steps have been considered to strengthen administrative capacity in order to ensure their effective use and absorption.

2.3.2 Knowledge demand

During the 1990s, public funding was mainly allotted on an institutional basis. NPRDI 1 by increasing the weight of project-based funding, took an important step towards research channelling, but priorities were too broad to focus research. This weakness has been addressed by NPRDI 2 which has identified nine strategic priorities as a result of the first Romanian foresight in S&T, with a broad national participation. The national consultations on R&D priorities involved managers of large companies involved in R&D activities, representatives of producers' associations, researchers and spokespersons from trade unions, while specialized systems and instruments for public consultation and for developing medium and long term prognoses have been used in order to set R&D priorities and objectives.

Innovation is the main NPRDI 2 instrument oriented directly towards enterprises, aiming to increase their technological development and innovation capacity and the assimilation of research results in production. It is structured in five modules: (1) *Product-system development*, (2) *Creation/development of innovation support infrastructure* (S&T Parks, technology transfer centres, brokerage centres, knowledge shops, technology incubators, innovation networks); (3) *Innovation support services in RDI units and innovative SMEs* (support for innovative clusters and networks, creation of scientific portals, virtual scientific fairs, dissemination of RDI results); (4) *Quality Management and Infrastructure* (support for quality certification infrastructure and implementation of Quality Management systems); (5) *European Cooperation* (support for participation in EUREKA).

2007-2008 Progress: To date, the Innovation Programme runs 208 projects under Module 1 and 5, the only modules launched so far.
2009: According to NASR decision (march 2009), projects contracted in 2007 within Module I will be co-financed from budget only to the limit of 51.9% of the committed funds. Projects contracted in 2008, currently in the implementation phase, will be supported up to 100000 RON (~25000 €)[24]. Public co-financing has been suspended for all the other 2008 projects. No further applications are received in 2009. (MASRITT, 2009)

The programme "Partnerships in priority S&T domains" stimulates the formation of consortia in nine priority S&T domains, in order to promote the achievement of innovative technologies, products and services. The distribution of funds across the priority fields is: 10% ITCs; 15% materials, innovative processes and products, 12 % agriculture and food safety, 14% health, 10% energy, 14% environment, 7% biotechnology, 8% security and space, 10% socio-economic and humanities research.

2007-2008: In the framework of this programme, there are currently running 1,375 complex R&D projects: 770 projects (out of 2291 submitted proposals) were selected in 2007, having a total budget of RON500m (~€155m[25]) and 605 (out of a total of 2905 submitted projects) projects in 2008.
In 2009 only 24.36% of the planned budget will be allocated to this programme. A further decrease is planned for 2010, while in 2011 a six fold, and respectively a tenfold budget increase in 2012 is foreseen. (NASR decision 10156/2009)

Signs that societal demands resonate in research projects can be noted, as is the case with certain environmental concerns and social assistance and integration issues (e.g. Roma minority). Through the *Sectoral Plan for research in the processing industry* financial support from the state budget is granted for projects devoted to the development of products and technologies for reducing energy consumption and increasing energy efficiency.[26]

The priorities of the National Roadmap for Research Infrastructure are rooted in the European society, aiming to support besides the pursuit of scientific excellence, the knowledge dissemination and to underpin policies for sustainable development in fields of major public concern such as health and environment.

Table 3: Main policy changes in the knowledge demand domain

Challenges	Main Policy Changes
Identifying the drivers of knowledge demand	• Nine priority fields are targeted by NSRDI 2007-2013 and five thematic priorities were identified in SOP-IEC by public consultation.
Co-ordinating and channelling knowledge demands	• The partnerships between public RDI organisation and enterprises support the efficient channelling of the knowledge production • The priority fields and area of interventions aim at improving the channelling process of knowledge demand. • Measures to monitor and provide easier access to public procurement have been taken
Monitoring demand fulfilment	▪ Monitoring and reporting procedures have been implemented.

[24] The approximate average 2008 – 2009 exchange rate €1= 4 RON
[25] As for 2007, € 1 = 3.21 RON exchange rate
[26] The proposed budgets for Sectoral Plan are as follows: €3.07m for 2009; €3.46m for 2010; €3.78m for 2011 and €3.94m for 2012.

2.3.3 Knowledge production

All the objectives of NSRDI target directly or indirectly the improvement of the knowledge production.

Ideas programme within the two operational schemes, as detailed below, supports projects of scientific excellence and international visibility. The "Exploratory Research Projects" Programme has as main objective "*the development of the knowledge in all the research domains*" and is aimed at small research teams. The "Complex Exploratory Research Projects" Programme targets the *"development of knowledge through fundamental research with advanced inter and trans-disciplinary character*", dispersing much higher budgets per project, requiring large research teams and institutional collaboration. The relative weight of the scientific quality of the proposal and the scientific authority of the team count to 75% in the evaluation process.

Progress 2007-2008*:* In the framework of this scheme, there are currently running 439 (selected out of 1,278 submitted projects) exploratory research projects with a total fund of ~€33.5m; for the 2008 competition there were submitted more than 1500 projects. The distribution by S/T fields shows the predominance of projects in fundamental and medical sciences.
2009 update: The budget for active projects will be cut up to 60%, while no calls are foreseen in 2009.

Complex research but carried within nine identified priorities is supported through the Partnerships programme (see details in section 2.3.2).

Various schemes under Human resources Programme aim to increase the number of researchers, the attractiveness of scientific careers and improve R&D performance.

Progress 2007-2008: In the framework of this programme, there are currently running 704 projects for young PhDs: 629 projects financed following the 2007 competitions and 75 projects (out of 420 submitted projects) financed in 2008 competition (NRP, 2008). A special scheme, "Awards for scientific excellence", offers financial incentives to authors of ISI papers and patents, under the condition that they are affiliated to a Romanian institution. During 2007, financial benefits were awarded for 526 articles and 8 registered patents.
2009 update: For all the schemes under Human resources Programme, as to this date (April 2009) due to the financial constraints imposed by the 2009 R&D budget, applications are not further accepted.

The RCRI delivered in 2007 "National Roadmap for Research Infrastructure" which identifies the national high-priority RI objectives, that require funds higher than €0.6m and a stable institutional frame given the long development period. It envisaged the development of 19 new research centres in ten S&T fields considered national priorities (see details in section 4.2). A different category to these RIs identified as priorities in a top-down manner, are those in fields with special potential, identified as such by scientific and business communities (bottom–up approach). The large investment projects for the development of public RIs are funded on a competition basis via two main instruments: "Capacities Programme, module I" (supporting projects less expensive than RON2m ~ €0.5m) and SOP-IEC, priority 2.2.1: Development of R&D infrastructures (for projects more expensive than RON 2m, but less expensive than RON 65m ~ €12.5m).

Progress 2007-2008: In 2008, first calls for large RIs were launched within these programmes, rated as a premiere after the year 1990. As a result, 29 large R&D projects were selected for the development of complex R&D facilities (20 through POS-IEC, with additional funding offered for 9 projects through Capacities Programme). In 2007, 140 projects with a RON200m (~€60.33m) budget were financed within Capacities Programme, module I. (NASR, 2007).
2009: As a consequence of the drastic cut of the 2009 RDI budget, the projects currently in progress under Capacities I will be financed only up to a level of 57% of the committed budget, while Capacities I and II projects selected in 2008 competition will be financed only in proportion of 46% of the contracted funds for this year. (ANCS, 2009)

The involvement of demand-side representatives in RDI projects encourages the focusing of research efforts towards clearly identified problems. The exploitability of research results is to be also improved through the Innovation programme, which finances projects initiated and developed by enterprises.

Table 4: Main policy changes in the knowledge production domain

Challenges	Main Policy Changes
Improving quality and excellence of knowledge production	▪ NPRDI 2 geared towards excellence. Human Resources Programme provides awards for scientific performance; ▪ Measures have been implemented to reduce fragmentation and to support poles of excellence; ▪ 2008: significantly increased budget for RIs and human resources.
Ensuring exploitability of knowledge production	▪ Collaborative (public – private RDI) requirements under the NPRDI 2 are expected to stimulate the exploitability of the research results; ▪ Both ex-ante and ex-post evaluation processes have been improved with a focus on quality and exploitability.

2.3.4 Knowledge circulation

In order to improve knowledge circulation between the research and business sectors the government has reinforced with the NPRDI 2 the policy of stimulation of R&D public private partnerships, through mandatory co-financing from the private sector. With regards the international knowledge circulation, most of the programmes encourage collaboration with foreign partners, while specific programmes have been designed to support Romanian participation in FP7, FPT EUROATOM, CERN.

Public-private

Knowledge circulation between national public and private R&D performers are supported by the Complex RDI projects (CEEX), Innovation**,** Partnerships in priority S&T domains (details in section 2.3.2). The scheme "Projects supporting PhD mobility" (under Human resources of NPRDI 2) offers support to PhD students for three months mobility in a research laboratory (public or private). *The R&D sectoral plans* (see section 2.2.1) also contribute to the development of synergies between the scientific community, the economic community and the civil society for rendering more efficient the R&D activity and transferring it into technology. Starting 2008, SOP-IEC PA2 allocates funds for large inter-sectoral collaborative projects, promoting the participation of foreign specialists and networking in the form of clusters of excellence, achieved through joint RDI projects and other complementary ways of collaboration (ex: networks, practice exchange). Relevant measures under SOP-IEC are detailed in Chapter 3.

A notable new policy measure adopted by NASR is the *'Innovation Road show'*, launched at the end of August 2008 as a series of conferences, seminars and

meetings between representatives of R&D institutions and firms, organised in all the development regions of the country.

International circulation

The Ideas programme supports the international mobility of Romanian teams for research activities and participation in international conferences (detailed progress in 2.3.3). In the frame of Capacities, module III supports financially national participation in bilateral cooperations, FP6, FP7, FP7 EUROATOM and CERN.

2009: The Capacities, module III projects awarded for funding in 2008 will receive the full committed finances for 2008, while in 2009 only funds for mobility will be allocated. (NASR 2009).

In September 2008, the first National Conference of Romanian Diaspora was organised, having the aim to enhance the links with the Romanian researchers working abroad. Measures targeting specifically integration in ERA are detailed in chapter 4 (such as bilateral agreements, foreign participation in national programmes, ERA-NETs, FP7, ESFRI etc).

Table 5: Main policy changes in the knowledge circulation domain

Challenges	Main Policy Changes
Facilitating knowledge circulation between university, PRO and business sectors	▪ Several programmes of the NPRDI 2 (i.e. Partnerships, Innovation, Complex Research Projects) and SOP-IEC support inter-sectoral and international circulation.
Profiting from access to international knowledge	▪ The Human Resource programme supports international mobility of researchers in terms of mobility and participation in international conference; ▪ Capacities Programme module III supports Romanian participation in bilateral programmes, FP7, FP7 EURATOM and in CERN projects; ▪ Some NRPDI2 programmes target specifically Romanian Diaspora and foreigners; ▪ International collaboration is stimulated through Structural Funds.
Absorptive capacity of knowledge users	▪ Measures supporting the absorptive capacity of knowledge users, especially SMEs have been adopted. Measures have been taken to improve access to public procurement

2.4 Assessment of main policy-related opportunities and risks related to knowledge demand and knowledge production

Following the analysis in the previous section, this section assesses whether the recent policy changes respond to identified system weaknesses and take into account identified strengths.

As detailed in section 2.3.1, broadly the new RDI policies respond to the national challenges. Specific funding instruments target the identified challenges and objectives, the NRDIS 2007-2013 representing the first integrated RDI strategy based on a SWOT analysis and large public consultation. The major opportunities identified are: (1) coherent RDI strategy elaborated on the basis of foresight exercise and large public consultation, (2) gradual increase of the RDI budget until 2008 and (3) the declared commitment of all political forces to enhance research. Empirical proofs[27] show that the measures implemented since 2006 already have a positive impact on the knowledge production and that the most important reason for the low scientific output was related to scarcity of R&D funds.

[27] Keyword search on SCOPUS database using as selection criterion Romania keyword under institution affiliation indicates the positive trend of the numbers of ISI papers with the increase of financial resources: 2405 (2004), 2985 (2006), 3583 (2007), 4428 (2008).

Despite broadly well designed and harmonised policy strategies, barriers remain. Romania has adopted European practices in S&T policy formulation and evaluation, the strategic governance being to a large extent influenced by the EU R&D policy. Nevertheless, it is arguable if the adoption of the Lisbon targets and of a R&D agenda mirroring the EU FP7 is well-suited to the Romanian national RDI system and to the broader needs of the economy.

There is a risk that the numerous measures targeted to increase the RTD potential in the business sector might not find an adequate response, especially given the prevalence of traditional industrial sectors in the Romanian economic landscape and the administrative burdens. In the national context lacking high tech industries, the prerequisite of academic-enterprise collaboration can limit the access to some of the programmes of R&D teams performing in advanced S&T fields.

The RDI system has remained fragmented, yet the recent prevalence of competition based RDI funding is aimed to support the scientific excellence. A positive example of the funding mechanism shift is represented by the HE sector which has registered a visible increase in its share of GERD, from 10.12 in 2004 to 24% in 2007, when funding through competitions open to all R&D performers became predominant (INSSE, 2009). However, some funding instruments are still directly targeting PROs, while other may indirectly restrict the participation of HEIs. While managing the lowest GERD share and not benefiting of block funding for R&D, the HE sector is the leader in terms of scientific output, producing ~60% of the total number of ISI papers published by Romanian R&D institutions. (Ad-Astra, 2006)[28]

Given that the RDI activities involve policy fields belonging to different ministries, the complex institutional landscape seriously limits the effectiveness of the NASR in coordinating the RDI related agenda. For instance, the responsibility for creating an enabling investment climate that encourages entrepreneurship, technology absorption and innovation lies with NASMEC. The lack of coordination, monitoring and of clear responsibilities for each actor involved in the implementation process, the lack of transparency and quality of evaluation[29] (Ad-Astra, 2009), as well as bureaucratic delays in respecting deadlines could compromise the attainment of strategic goals. Unless efforts are expressed in a coherent, transparent and consistent manner, the new RDI policy may lead to now significant results.

As for **2009**, given that the recession has a major impact on R&D budget, the long-standing challenges faced by the Romanian RDI system may bring it to collapse after its short term resuscitation. The human resources base is the most sensitive to the new turn around. As the younger researchers will be likely most affected in terms of employment and mischief hopes, Romania may face a new dramatic brain migration, while loosing in the future the ground for attracting the Romanian Diaspora. While hopes are that the RDI budget will be increased due to the International Loan, all the RDI stakeholders raised the awareness that the "damage has been already done". The 2009 budget law showed that the RDI remains too sensitive to political and economic context, regardless consistent, systemic political commitments.

[28] According to Ad-Astra statistics around 60% of the ISI papers are produced by HEIs

[29] While good evaluation procedures are in place, the 'evaluations of evaluators' is missing. According to Ad-Astra, more than 50% of evaluators involved in NPRD have not published any ISI paper, although the registration in the National Registry of Experts in Research, Development and Innovation is conditioned by *"national and international scientific prestige proven by publications, awards and research grants"*

Table 6: Summary of main policy related opportunities and risks

Domain	Main policy opportunities	Main policy-related risks
Resource mobilisation	• A strategic vision of long-term investment is reflected in many policy documents, which complement each other. • Significant increase of public funds for RDI in 2007, 2008 • Measures and support schemes to increase attractiveness of research careers and improve the RIs have been initiated.	• Frequent changes and interferences of political factors; • Unstable global macro-economic and national political conditions have impacted the RDI budget; High inflation rate.
Knowledge demand	• Strategic identification of issues and challenges in a long term perspective: National R&D priorities for 2007-2013 based on foresight exercise; • Better channelling of knowledge demands sustained by measures adopted in 2007; • Increasing awareness towards competitiveness and importance of the knowledge economy	• Low proportion of innovative enterprises and prevalence of manufacturing industry. • Lack of interest by the private sector
Knowledge production	• Prevalence of competitive funding • Open access to public funds of all RDI performers • Project evaluation oriented towards excellence. • Integrated monitoring system including measurable strategic targets and output indicators.	• Delayed and inconsistent policy implementation may jeopardise the attainment of the objectives. • Uncertainty over long-term supply of human resources for strategic S&T areas. • Good evaluation procedures are in place, yet lack of transparent and quality evaluation can lead to the situation in which public money will be channelled to minority groups.
Knowledge circulation	• Various programmes support inter-sectoral and international scientific cooperation	• Delayed and inconsistent implementation of the measures

3 Evolution of national policy mixes towards Lisbon R&D investment goals

*The aim of this chapter is to deepen the analysis of national policy mixes with a focus on public and in particular **private R&D investment**. The Lisbon strategy emphasises an EU overall **resource mobilisation objective** for 2010 of 3% of GDP of which two thirds should come from private investment. R&D investment is seen as important yardstick for the capacity of an economy to turn the results of science and research into the commercially viable production of goods and services and hence knowledge into growth. Corresponding investment policies are mainly pursued at national level and determined with a national focus.*

The chapter is structured around five questions:

1. *What are the specific barriers in the country regarding to reaching the Lisbon goal? Thus what barriers exist in the country to reach the specific targets, particularly related to the private sector R&D investments?*
2. *Given the above, what are the policy objectives and goals of the government to tackle these barriers?*
3. *What Policy Mix routes are chosen to address the barriers and which specific instruments and programmes are in operation to implement these policies?*
4. *What are the achievements in reaching the above mentioned R&D investment objectives and goals?*
5. *What are the reasons for not reaching the objectives, adaptation of the goals?*

Thus the chapter aims to capture the main dimensions of the national policies with an emphasis on private R&D investment. The chosen perspective of looking at investments in R&D is the concept of Policy Mixes. The analysis and assessment follows a stepwise approach following the five questions mentioned above.

3.1 Barriers in the research system for the achievement of R&D investment objectives

National and international economic context.

In 2008, Romania continued to improve its economic performance, showing one of the highest economic growth rate in the region. Romania's gross domestic product (GDP) advanced 8.2% in the first three months of 2008 over the same period of 2007, beating analysts' expectations. As the financial crisis intensified in autumn 2008, national economic indicators deteriorated and global economic activity has started to fall sharply. The slow down in the economic growth from ~8% to 2.9% over the last quarter of 2008, limited the GDP growth to ~7.8 % in 2008. In early February, the expectation of the National Bank of Romania regarding GDP growth was below the 2.5% figure considered in the 2009 budget law. Given the national and worldwide economic evolution, recently, the European Commission (EC) revised downwardly to 0-0.5%, the January 1.8 % estimation related to Romania's economic growth.[30] GDP growth is projected to slightly rebound as from the first half of 2010 to just below 2.5 % (EC, Interim Forecast 2009). Romania's significant annual GDP growth averaging 6.2%, between 2002 and 2007 has been complemented by rising external imbalances. The current account deficit widened from 2.5% to ~14% of GDP in the same period (Pauwels S, 2009). Romania's economic growth has implied large external imbalances and has relied on increasing volumes of foreign capital inflows. The 2009 economic prognosis indicates very high uncertainty and volatility of all macro-economic national indicators such as GDP and inflation rate. This is accentuated by the weak budget programming mechanism, with many annual budget amendments despite the multi-annual budget (SAR, 2009). All these aspects will directly and indirectly influence the R&D expenditure in the next couple of years.

Low Private R&D expenditure. Low innovation culture. Lack of tradition of collaboration public-private in R&D activities.

The overall level of in-house R&D activity is not known precisely, in particular due to disincentives for recording expenses. Although one of the innovation growth leaders in the group of catching-up countries, Romania still ranks the third to last among the EU-27 countries, with a value of the Summary Innovation Index (SII) of ~0.25 (2008) (European Innovation Scoreboard [EIS] 2008) compared 0.18 in 2007 (EIS 2007). In 2008, very low values compared to the EU-27 average were recorded for: 'intellectual properties' indicators (virtually zero); lifelong learning (1.3 counting to 13.4% of EU27 average); public-private co-publications (10% of EU27); business R&D expenditures (18.8 % of EU27); private credit (19.8% of EU27), innovative SMEs cooperating with others (30%). In 2007 (compared to 2006), two significant increases should be noted: the venture capital (from 0.004 to 0.067, reaching 62.6% of EU27) and public R&D expenditure (0.31 compared to 0.21). In 2006 (the latest available data), there were 6013 innovative enterprises (21.1% of the total 28488 companies), showing a slight increase compared to 2004 (5171 counting to 19.9% of the total) (INSSE, 2009). The share of non-R&D innovators in Romania is ~50 % higher than the EU-27 average

[30] According to the data recently released by INSSE (September 2009), in the second trimester of 2009 the GDP has decreased with 8,7% compared to the same period of 2008, while in the first semester of 2009 the decrease was 7,6% compared to 2008

(INSSE, 2006). The high share of non-R&D innovators is a consequence of the relatively low domestic R&D base and technology acquisitions based primarily on FDI. The innovation in the industry sector and services is based mostly on new equipment and technology acquisitions and much less on intramural or extramural research activity. Low costs continue to be the main source of competitiveness.

Industry and FDI distribution

The Romanian economy exhibits the features of an economy pre-occupied with restructuring traditional industries and finding its way in a new market setting, not of one firmly on the path to establish new R&D intensive industries. National industry structure reflects the prevalence of traditional industrial sectors, which use relative low technologies and show a weak demand for knowledge.

Foreign direct investment (FDI) can play a significant role in private R&D especially in the new Member States (MS). Fuelled by large privatisation programmes, FDI was encouraged by the relatively low labour cost, proximity to the euro-area, successful disinflation, high economic growth rate and increasing domestic market potential. FDI intensity rose from 1.3 % in 2002 to 4.8 % in 2007.[31] Three elements have to be considered when assessing the potential future impact of FDI on R&D and the adequate policy mix to support this route:

- Although the rapid growth in FDI proves that Romania is an attractive destination for investing foreign capital, the distribution of the FDI stock, with more than 1/3 share in the manufacturing sector, is not encouraging for R&D performing activities.[32] Other sectors attracting FDI are the banking and insurance sectors (22.2%), commerce (12.2%), telecommunications (8,2%), constructions and estate transactions (6.4%) (INSSE, 2006).
- The boom of privatisation-led FDI is now largely over, while the low-cost advantage is gradually eroding in certain sectors due to skill shortages, partly due to large outward migration. The experience in the EU-8 has taught that as industry restructuring progresses, the relative importance of cheap labour declines and other factors such as the business environment and infrastructure, availability of skilled labour will become a more prominent prerequisite for foreign investors. (Pauwels S and Ionita L, 2008)
- The attraction of foreign capital for R&D activities is well known of having the potential to trigger the migration of highly skilled nationals by external delocalization of R&D centres. This situation had occurred in Romania in mid '90, when many foreign software companies had considered more profitable to dissolve the Romanian branches, while relocating abroad the Romanian employees.

Weak public administration. Lack of awareness and transparency of public procurement. Inefficient judiciary system. Low business infrastructure.

Recognized and further highlighted by the Council Recommendations Romania's economic and social development remains hampered by weak public administration

[31] As of 31 December 2007, the FDI net flow was € 7,250m and the FDI stock amounted € 42,770 m. Statistics recently released (2009) from the Romania Central Bank show an increase of FDI with 25% during 2008, reaching €9.02b.

[32] 32.9% for manufacturing, out of which the largest recipients were: metallurgy (7.5%), food, beverages and tobacco (5.2%), oil processing, chemicals, rubber and plastics products (4.4%), transport means (3.6%) and cement, glassware, ceramics (3.5%). Starting 2008, the composition of FDI inflows has changed. The share of equity inflows shrank from 59% in 2004 to 13% in 2007, while intercompany loans have become more prominent, rising from 13% to 52% in the same period.

and an inefficient judiciary system. "*Ineffective oversight and lack of independence of regulatory and supervisory authorities often results in failure to tackle non-competitive market behaviour, while the corruption still affects the business environment and access to and quality of the public services*." Romania continues to operate one of the most burdensome tax administration systems in the world with companies paying 113 taxes per year (EC,2009). With regards the business environment, in 2008 Romania has moved up from 55th to 47th place in the World Bank's Doing Business report, but still ranks in the lower half among the EU MS. These problems affecting overall the economy are bounced to limit also the efficiency of the R&D strategy and targets. The insufficient and poorly diversified entrepreneurial base poses serious problems to the economic development of the country, especially in certain regions and areas that are lagging behind in terms of economic development.

Long term consequences of the chronic low RD investment.
The chronic low RDI funding brought the science base in obsolete state. Improving human resources involved in RDI activities (in terms of number and the level of performance) and their distribution by branches, fields of research and regions according to the economic and social needs remain an important challenge. Consistent financial efforts must be undertaken to bring the RI at an international competitive level and high-tech sector requirements.

3.2 Policy objectives to address the above barriers to R&D investment and recent policy changes

In terms of private R&D the NPRDI has the following objectives: (a) gradual increase of public and private RDI expenditure by 2013, in line with the Lisbon 3% target; (b) improvement of the RD base (better RIs, improved public funding system and critical mass of researchers in key areas); (c) establishment of a coherent legislative framework that stimulate the public-private partnerships in S&T; (d) design of mechanisms that support private investment in R&D; (e) establishment of a suitable environment for entrepreneurial activities in universities, RDI institutes and other RDI units; (f) intellectual property protection.

SOP IEC (PA2) aims to support the increase of Business Expenditure on Research and Development (BERD) by (1) providing finances directly to innovative private companies, (2) by supporting partnerships triggered by demand and (3) by bridging a market gap in terms of RIs in order to allow the development of clusters and poles of excellence.

Fiscal incentives for RDI activities are foreseen in the major policy documents, such as NRPDI 2, NSRDI 2007-2013.

3.3 Characteristics of the policy mix to foster R&D investment

This section is about the characterisation of the national policy and instrument mix chosen to foster public and private R&D investment, and its governance. While policy goals are often stated at a general level, the policy mix has a focus on how these policy goals are implemented in practice. The question is what tools and instruments are set up and in operation to achieve the policy goals? The following sections will each try to tackle a number of these dimensions.

3.3.1 Overall funding mechanisms

In 2007 GERD was financed 67 % (if the University General Public funds amounting to 7% of total GERD are included) by public funds. The rest of GERD is covered by business sector (27%), HEIs (1%), external funds (4.54%) and non-profit organisations (0.05%) (INSSE, 2009).

According to the latest statistics data available (INSSE, 2007), in 2006, ~39% of total R&D funds were allocated to fundamental research, 51% to applicative research and 10% to experimental development. The relative weight changes in the favour of fundamental research performed in PROs and HEIs. Given the implementation of the new RDI strategy these figures may not hold relevance for the current situation of the RDI system. The institutional funds directed to the network of research institutes coordinated by the Romanian Academy are mainly devoted to fundamental research. These institutes can also participate in the competition-based national RDI programmes. In addition, basic research is funded mainly through the Ideas programme (~€841m[33] multi-annual budget, representing 18% of total NPRDI 2), administrated by NURC.

In 2008 public funding was primarily channelled through MERI-NASR (89,2%), being further allocated to different R&D actors predominantly on a competition basis. The remaining part of the public funds was divided between the Romanian Academy (~10%), other academies and the ministries involved in R&D activities.

2009: According to the 2009 budget law, within the context of the drastic reduction of the public R&D budget, the share allocated to MERI was reduced to 80.9% (63.8% representing payments for 2008), the nominal funds showing a decrease to almost half of the 2008 figure. While the competition funding has decreased considerably, the block funding distributed to the Romanian Academy has increased with ~31% compared to 2008 and its share to 17,08%.(NASR, 2009)

The national RDI strategy 2007-2013 identifies nine thematic directions of particular interest for applied research and technological development and underlines the importance of basic research. NPRDI 2007-2013 as the main instrument of NSRDI allocates ~€4700m to all national RDI performers on a competition basis. Most (60%) of the NPRDI 2007-2013 funds for R&D activities are granted on the grounds of scientific and technological excellence, irrelevant to the S&T field. Public intervention in areas where long term vision and systemic approach are required is drawn on thematic priorities. This is the case of Partnerships in priority S&T domains Programme (~ 36 % of NPRDI 2 funds) and National Roadmap for RIs. Currently the funding mechanisms do not allow grants portability. University research is primarily funded on a competition basis within the programmes co-ordinated by NURC.

Structural funds for RDI. The funds (€536m SF and around €110m national contribution) administrated through the POS-IEC Programme, in the period 2007-2013, will be dispersed through target groups on a competition basis. Interventions will mainly focus on five thematic priorities: (1) Health; (2) Agriculture, food security and safety; (3) Energy; (4) Environment; (5) Advanced materials, products and processes, which could have the most significant impact on the increase of economic productivity. Several operations support the participation of the private sector in RDI activities, by 2015, €170m will be directed to private organisations for this purpose.

[33] The figures represent the planned multi-annual budget, using the 2007 exchange rate of 3.21

3.3.2 Policy Mix Routes

The "Policy Mix Project" identified the following six 'routes' to stimulate R&D investment:

6. *promoting the establishment of new indigenous R&D performing firms;*
7. *stimulating greater R&D investment in R&D performing firms;*
8. *stimulating firms that do not perform R&D yet;*
9. *attracting R&D-performing firms from abroad;*
10. *increasing extramural R&D carried out in cooperation with the public sector;*
11. *increasing R&D in the public sector.*

The routes cover the major ways of increasing public and private R&D expenditures in a country. Each route is associated with a different target group, though there are overlaps across routes. The routes are not mutually exclusive as, for example, competitiveness poles of cluster strategies aim to act on several routes at a time. Within one 'route', the policy portfolio varies from country to country and region to region depending to policy traditions, specific needs of the system etc.

Route 1: Promoting the establishment of new indigenous R&D performing firms

In Romania, the term *'innovative start-ups'* is generally included in the broader category of SMEs. Generic support policies and programmes for SMEs fall primarily under the responsibility of the NASMEC within the Ministry of SMEs, Trade, Tourism and Liberal Professions, while specific programmes related to R&D are coordinated by the NASR. The two agencies recently signed a Collaboration Protocol aimed to promote innovative SMEs, stimulate creativity and entrepreneurial culture in R&D and develop an adequate infrastructure for RDI units and SMEs.

Starting 2008, under the SOP-IEC Programme, a special scheme 'Support to start-ups and innovative spin-off'[34] offers support to the innovation activities of high-tech or high added value to start-ups and spin-offs in order to ensure the transfer of knowledge and technology and to assist the respective enterprises in commercialisation of products and services derived from research. The projects can be financed with €0.2m[35] dispersed during 3 fiscal years, in a co-financing scheme requiring that 10% will be covered by the applicant. With a multiannual budget of €18.5m a continous competition was launched in 2008. In 2008, 5 out of 7, while in 2009, 6 out of 9 submitted projects were accepted for funding The operation is complementary to SOP-HRD PA „Increasing the adaptability of workers and enterprises", which promotes training programmes for the development of entrepreneurial and managerial skills, as well as support services for initiating new businesses.

According to stakeholders' debates, the Romanian market lacks financing tools for start-ups. In reply to this evidence, the Post-Privatisation Foundation[36] in agreement with EC tries to find a strategic solution that can offer financial support as seed capital for start-ups.

Route 2: Stimulating greater R&D investment in R&D performing firms

NRDPI and SOP-IEC, through several programmes allot public money on a competition basis to R&D activities carried out in enterprises within specific co-funding regulations.

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[34] Innovative start-up and spin-off as defined in the above mentioned legislation are enterprises that have intellectual propriety rights over an innovative product (such as patent, licence, prototypes, know-how etc) and maximum 20 employees

[35] Except for enterprises in the field of Transportation where the limit is of €0.1m

[36] Post Privatisation Foundation (FPP) is jointly managed by the European Commission and the Government of Romania. Set up as a Romanian apolitical and not-for-profit legal entity, its aim is to financially support Romanian small and medium-sized enterprises http://www.postprivatizare.ro/en/

NPRDI 2 finances R&D activities in enterprises mainly through the Innovation Programme (see section 2.3.2), which to date runs 208 projects. Most part of the R&D activities and consequently, of the innovation capacity is concentrated in the Hi-Tech industry and in Bucharest, shadowing the neighbouring S and SE Regions.

Under SOP-IEC PA2, a special programme dedicated to "R&D Projects of high scientific level involving foreign specialists" with RON 60 mil (€16.9m) budget has been launched in March 2009 (evaluation period September-October 2009). The program is aimed to create poles of S&T competence,[37] by involving specialists with international experience and high scientific performance.

The programme "Development of R&D infrastructure in enterprises and creation of new R&D jobs" supports in the range €(~0.25÷10)m[38] the procurement of R&D instruments and equipments, complemented by modernisation or enlargement of R&D sites. The maximum non reimbursable public support is 50% for large, 60% for medium and 70% for small enterprises.[39] The first competition was launched in 2008 and €126.3m from SOP-IEC budget, supplemented by ~€33.1m from NRPDI 2 were allocated to finance 29 projects (selected out of 35 submitted).[40]

The *Sectoral Plan for research in the processing industry* also stimulates the RDI activity in industrial sector offering support for the development of products and technologies aimed to reduce energy consumption, impact on environment and to increase energy efficiency. 31 contracts are currently ongoing and projects for 19 research themes in processing industry sector are under the evaluation procedure (NRP 2008).

Route 2 is closely linked to route 5, i.e. public-private collaboration and the specific schemes will be detailed under this route. Some tax incentives are aimed to stimulate R&D activities (see dedicated section on tax incentives).

Route 3: Stimulating firms that do not perform R&D yet

Under SOP-IEC, PA2, the operation "Promoting innovation in enterprises", with a total budget of RON200m (~€56.34m) is aimed at stimulating the R&D activities in enterprises in order to apply in production new or improved products, technologies and services. The scheme offers financial support for the acquisition of R&D services and application rights of R&D results. The non reimbursable public is up to 15 Mil RON (~€4.5m) and 3.5 MRON (~€1.1m) for new innovative enterprises. Eligible to this scheme is any enterprise (with or without R&D activities in its status) and new[41] innovative enterprises. The first competition was launched in November 2008 and closed in March 2009.

The IMPACT programme (2006-2010) offers consultancy support for the preparation of proposals submitted by national enterprises within SOP-IEC PA2.

Route 4: Attracting R&D-performing firms from abroad

The Romanian branches of multinational companies such as SIEMENS, ALCATEL, MICROSOFT, ORACLE, INFENEON have around 5500 employees involved in IT and R&D activities. Given the availability on the national labour market of highly

[37] Eligible applicants are legal entities with R&D activities in the status
[38] 2009 exchange rate
[39] The participation for each group is with 10% smaller in the region Bucharest-Ilfov
[40] ANCS, http://www.mct.ro/index.php?action=view&idcat=645
[41] New innovative enterprises are defined as enterprises with minimum one, but not more than six years experience and have invested in the last 3 years in R&D activities minimum 15% of their operational costs

skilled IT specialists and the low investment costs that the R&D in the software sector requires, Romania has always been attractive for foreign investments in this sector.

No specific measure can be identified as specifically designed to attract R&D performing firms from abroad. Given the FDI distribution and evolution (as detailed in 3.1), still preserving a complicated administrative system, a weak business environment and inefficient judiciary system (EC COM2009), Romania must consider sustained efforts to efficiently implement this route, especially in sectors that require long term and high investments.

Route 5: Increasing extramural R&D carried out in cooperation with the public sector

The increase of enterprises competitiveness by the development of R&D activities and of their own innovation capacity has continued to be supported, especially, by the following instruments to promote cooperative R&D with the public sector:

Complex RDI projects, funded under CEEX (2005-2008) stimulated the partnership between research institutes, universities and companies. "Partnerships in priority S&T domains" stimulates the formation of consortia in nine priority S&T domains (see details in section 2.3.2). The territorial distribution indicates that Bucharest is the main concentration pole of the research potential, with 2/3 of the total number of complex partnerships coordinators.

SO-IEC PA2.1, "Research projects in partnerships between universities, institutes and enterprises" with a total budget of RON 400 mil (approx. €112.7m) stimulates a different type of private-public collaboration. In these projects, the partner enterprise which will retain the intellectual property rights over the research results, delegates the RDI activities to a R&D performing organisation. Enterprises with or without R&D activities included in their status, but not having the R&D as main activity, are entitled for this type of funding. The first competition was launched in March 2009 and the estimated budget is RON 400 mil (~€94.m).

Another SO-IEC operation, "*Development of poles of excellence*" is dedicated to the development of research-driven poles of excellence. These poles are aimed to group together enterprises, research institutions, training centres, etc, which by active partnerships will perform activities with the same market objective, guided by a common development/business strategy. The first call will be launched in 2009. The operation mainly supports the development of joint facilities of the pole, while the research activities of the pole and individual investments in research infrastructure may be supported by other operations within the SOP-IEC PA2. The maximum value of the non-reimbursable financing for a project is €3.75m. The first competition for this operation is scheduled in 2010.

The low level of RDI funding after 1990 having as results the low performance of RDI activities has also drastically hindered enterprises' access to suitable RDI infrastructure. Against this background, any programmes (as detailed in section 2.3.3) dedicated to the development of RIs and human resources in research can be assessed as mechanisms having the premises to stimulate the extramural R&D activity carried out by enterprises.

Route 6: Increasing R&D in the public sector

Public R&D expenditure in 2008 (€713m) has more than doubled compared to the 2006 level (€324m). The share of GBAORD in total general government expenditure has gradually increased from 0.47 % in 2003 to 0.96% in 2007. The share of public

R&D expenditure in PROs increased with 51.4% in 2007 compared to 2006, while in the same period, the public share has almost doubled for HEIs (95% increase) (INSSE, 2008). Various programmes implemented within the frame of the **NPRDI 2** are detailed in chapter 2. Three operations under **SOP-IEC, PA 2** are specifically targeting the public sector (PROs and HEIs). The Development of national R&D networks linked to European and international networks operation aims to increase the involvment of nationals in international specialised research networks, such as GRID, and the development of the national network RoEduNet in order to approach the GEANT standards. The operation was launched in June 2008[42]. Strengthening the administrative capacity operation is aimed to support the development of R&D administrative and management capabilities of PROs and HEIs. The first competition was launched in June 2008[43] and a second one in July 2009. The operation Development of RIs and creation of new RIs supports in the limit of a RON60m (~€14m) budget the development of RIs in the public sector.

Programme Research of excellence (CEEX) was active until end of 2008, with an overall budget of €730m disbursed through four modules: (1) Complex Research projects; (2) Projects for young researchers; (3) The promotion of the participation in European and international research programmes; (4) Projects for the development of RIs. In 2007 and 2008, for each year were allocated ~810 MRON (~€200m). Within the four modules of the programme, 1300 research-industry partnerships were promoted (NRP, 2008). Formal evaluations of the programme for the years 2005, 2006 and 2007 are available on NASR website.

Assessment of the importance of policy mix routes and their balance

As evidenced by the above section and summarised in the table below, the policy mix chosen in Romania contributes mostly to routes 2, 5 and 6. Route 2, stimulating greater R&D investment in R&D performing firms, is closely linked to route 5, i.e. public-private collaboration and several funding instruments are attached to it. Route 2 is also complemented by indirect measures such as tax incentives. The co-financing of research projects launched by companies, in particular of those projects involving the cooperation with the universities and research institutes, is considered the core of the actions supporting private R&D investments.

Table 7: Importance of routes in the national policy and recent changes

Route	Short assessment of the importance of the route in the national policy	Main policy changes since 2008
1	Some policy focus on direct instruments targeting spin-offs and innovative enterprises	'Support to start-ups and innovative spin-off' scheme, with € 18.5 m multi-annual budget has been launched in 2008. Various indirect measures have been implemented in 2008 (improvement of entrepreneurial culture, business environment)
2	Major policy focus - several direct measures, complemented by tax incentives.	Dedicated NRDPI and SOP-IEC programmes enable the allocation of public money to R&D activities carried out in enterprises within specific co-funding regulations. Closely linked to route 5. Complemented by tax incentives.
3	Minor policy focus	Promoting innovation in enterprises launched in 2008
4	No evident policy focus	None
5	Major policy focus	Since 2007-2008, a range of policies and funding instruments support the collaboration between RDI performers
6	Major policy focus	With implementation of NPRDI 2, the public RDI budget has increased twofold.

[42] 11 out of 15 submitted projects were accepted for funding
[43] 21 projects out of 22 eligible projects were accepted for funding

The importance of education and innovation policies

Romania has made major steps towards the European Higher Education Area (EHEA). A new higher education structure has been adopted by the Law 288/2004 on the organization of university studies, providing the legislative framework for the introduction of the three cycles, according to the Bologna objectives. The Law came into force in the 2005/2006 academic year and the first generation of Bachelor students will graduate in 2008/2009 (MERY, 2007). New curricula as well as new universities have been set up under the reform programme and the number of students enrolled in various study programmes has been steadily rising. Overall the budget for education continuously increased since 2005, as follows: from 3.9% of the GDP in 2005 to 6% in 2008 (MERY, 2008). Nevertheless, the HE system, as the main provider of qualified human resources for R&D still lags behind the European level. Romania registered a high growth rate of tertiary S&T graduates since 1994, in 2005, the share of tertiary S&T graduates per 1,000 of population aged 20-29 years reaching 10.3% (compared to EU27 average of 12.9%) (EIS, 2007). In the same year, the share of S&T PhD students in the same population segment was 0.23% (ranking 18th among the EU27 countries) (EUROSTAT, 2007). The National Agency for Qualifications in Higher Education and Partnership between Universities and Socio-Economic Environment (ACPART) was set-up as specific body having the mission to promote the partnerships between HEIs and the social and economic environment. "UNISO – UNIversities for SOciety" Programme, coordinated by ACPART was established with the purpose to foster regional university-industry linkages in Romania and to increase public awareness on the role of entrepreneurial universities in society. SOP-IEC *PA 2* is complemented by SOP - HRD PA 1 "*Education and training in support for growth and development of knowledge based society*" (with ~€992m allocated funds). The Key Area of Intervention (KAI) 2 "*Quality in higher education*" supports networking of HEIs, PROs and enterprises with the aim of enhancing the university education and ensuring training of researchers. The research conducted during the doctoral and post-doctoral programmes within the frame of SOP - HRD KAI 5 *"Doctoral and post-doctoral programmes in support of research*" is aimed to stimulate the technology transfer, the creation and the development of high-tech firms and of poles of excellence.

Other policies affecting the R&D investments

Public consultations and EC monitoring activities indicate among other factors, the excessive administrative burdens at all level of the administration, inefficient judiciary system and low access to public procurement as important national drawbacks, preventing the establishment of an efficient business environment (EC, COM(2009)). While not specifically targeting R&D performing private firms, measures addressing these chronic national weaknesses do affect in the policy mix interplay the establishment and development of RDI enterprises. Relevant measures are detailed in Annex 2.

Tax incentives

The standard rate of income tax for Romanian and non-resident companies that do not have an effective management in Romania is 16%. In January 2009, as a measure to support economic growth and decrease of the crisis impact, tax exemption was introduced in respect of dividends reinvested by the dividend payer's, with the purpose of maintaining or increasing the number of jobs. Since December 2008, a supplementary 20% deduction in addition to the normal deduction obtained via (amortisation of) R&D expenses was introduced. Machinery and equipment used

for R&D may also benefit from the accelerated depreciation method.[44] Other relevant tax incentives implemented in 2007 and currently active are provided in Annex 3.

3.4 Progress towards national R&D investment targets

Resource mobilisation

The 2005 state budget for R&D increased by 60% over the 2004 figure and raised again in 2006, the GBAORD reaching the level of 0.33%. In 2007 the GERD was 0.53%, with a GBAORD figure of 0.37%. In 2008, GBAORD was planned to reach 0.69%[45] and to be further increased to 0.86%, respectively 1% of GDP in 2010 (NRP, 2007). The 2008 GBAORD (€603m) has increased with almost 40% compared to 2007. In these terms, Romania is one of the 17 MS showing high R&D intensity increase after 2000, indicating that efforts have been considered to reach the Lisbon target. Nevertheless, Romania R&D intensity still lags well behind the EU average, Romania being the second lowest in terms of R&D intensity. Consequently, the "catching-up" effect has to be considered when assessing the favourable increase of the R&D intensity.

	2005	2006	2007	2008
GERD (€ million)	327	444	653	**na**
R&D intensity (GERD as % of GDP)	0,41	0,45	0,53	**na**
GERD financed by government as % of total GERD	53,5	64,1	67,1	**na**
GERD financed by business enterprise as % of total GERD	37,2	30,4	26,9	**na**
GERD financed by abroad as % of total GERD	5,3	4,1	4,5	**na**
GBAORD (€ million)	174	324	435	603
GBAORD as % of general government expenditure	0,65	0,94	0,96	**na**
BERD (€ million)	163	215	272	**na**
Business sector R&D intensity (BERD as % of GDP)	0,20	0,22	0,22	**na**
BERD financed by government as % of total BERD	36,8	47,0	42,5	**na**

Data Source: Eurostat

While the GERD increased twofold in 2007 compared to 2003, in the same period, BERD has only slightly increased from 0.20% to 0.22 %. Comparing the considerable budgetary funds spent in the business sector with the decreasing participation of this sector to GERD leads to the conclusion that the public funds brought about a "substitution effect" instead of the desired "complementary-like effect" (Sandu and Paun, 2008).

NASR projection of the RDI expenditure in the private and public sector is detailed in the table below.

	2008	2009	2010	2011
R&D intensity (GERD as % of GDP) [(a)]	1.1	1.36	1.6	1.8
BERD as % of GDP[(a)]	0.4	0.5	0.6	
State budget funds as % of GDP (Projected) [(a)]	0.69	0.86	1	
State budget funds (**€ million**) [(b)]	713.3	986	1327	

Data Source:
[(a)] National Prognosis of the R&D budgets (NASR, 2007)
[(b)] The 2008 law of state budget

[44] http://www.internationaltaxreview.com/includes/magazine/PRINT.asp?SID=717811&ISS=25321&PUBID=35
[45] According to unofficial data although the 2008 RDI budget has been kept in its committed values, it represents ~0.35% of GDP given the very high increase of GDP.

2009 updates. The **2009 GBAORD commitment** is **€986m (~0.86% of GDP**) (NRP, 2008). According to the 2009 law of state budget, the **2009 public budget for R&D decreases drastically, to €320m (0.27% of GDP**). **This figure represents only ~30% of the committed 2009 budget and ~50% of the 2008 budget**. According to NASR, a substantial amount of the 2009 R&D state budget represents debts for 2008, that leads after the debts' payment to a real budget representing only 35% of the 2008 figure. The budget law has passed through several modifications, the initial state budget proposing 0.19% of GDP as public expenditure on RDI. The drastic cut of R&D budget has generated intense public concern that this measure will lead to the obsolete state of the R&D system, especially in terms of human resources.[46] There are however hopes that the budget recalculation after the international loan will allocate more finances for R&D.

A €5b EU loan if approved will be provided in conjunction with the International Monetary Fund (€12.95b). Additional support of two billion euro will be provided by the World Bank (€1b), the European Investment Bank and the European Bank of Reconstruction and Development (€1b together).

Policy mixes towards increased R&D

The several strategic policy documents which act as a framework for the governance of the Romanian S&T policy emphasise the necessity of long-term investments in R&D and adopt a 'systemic approach' providing some strategic orientation for the system and the frame for the R&D spending in the country.

Surveys (EC, 2005) suggest that when investing in R&D, business primarily looks for: (1) favourable framework conditions for the commercialisation of technologies; (2) adequate numbers of well-trained and mobile researchers, responsive to the needs of industry; (3) excellent public research base (research institutions and infrastructures) with strong interactions with industry. The current national policy mix is broadly relevant to the national challenges in terms of pertinence and coherence, targeting the drivers for private R&D as described above. It can be interpreted as a result of premeditated coordination of policy strategies. It aims to correct the main weaknesses of the Romanian RDI system, while creating a better environment for business to invest in R&D. The analysis shows that the policy mix is primarily oriented on direct instruments, with an emerging tendency towards implementation of indirect instruments, such as tax incentives and better regulation for business sector.

In the context of the undergoing changes, while too premature to estimate the long term impact, several potential barriers for the achievements of the strategiec targets can be identified.

Complex interplay of policies such as human resources supply, macro-economic and political stability, administrative procedures, fiscal regimes etc must be considered when assessing the capacity of promoting the private R&D. Although some steps have been made to address the persistent weak public administration, inefficient judiciary system and low access to public money, these remain important drawbacks. As detailed in section 3.3.2, the level of participation and competition in SOP-IEC PA 2 has been very low. Among the main factors that may have generated this situation can be the lack of timely and efficient public awareness actions prior to the calls and reluctance of the targeted segment to participate in these calls. On one side, the later could be triggered by complex application procedures or fear of well-established and

[46] http://www.ad-astra.ro/posts/view_post.php?post_id=1175&lang=ro

well-known defective routines and evaluations, often showing political or other sort of favouritism. On another side, the enterprises may hesitate to increase their competitiveness based on RDI activities because of high market risks and technological uncertainties.

Access to tertiary education and life long learning remains below the average. There is still lacking a realistic analysis of the required contributions of the system to attain the objective of creating a dynamic and efficient macroeconomic environment. The system will be positively influenced only if educational offer is correlated with the demands of the system and an efficient investment model. The mismatch between the labour force supply and demand and the inadequate level of skilled labour may lead to an equilibrium in which outdated technologies remain the optimal choice.

A good RDI policy should show vertical, horizontal and temporal coherence. The Romanian RDI policy to some good extent features vertical (ministerial action plan) and temporal coherence. NRPDI policy instruments are aligned and mutually supportive of each other. In the context of the complex institutional landscape it is not clear if it does span coherently across ministerial boundaries (horizontal coherence).

Foremost, policy risks are related to the implementation process. While with NRSDI, a good RDI policy is mainly in place, so far Romania showed that has difficulties in addressing one of the common problem among all catching-up economies, namely the well established institutional routines, habits and customs. The design of ministries, agencies and policy mechanisms may make difficult to implement effective the RDI policy.

Table 8: Main barriers to R&D investments and respective policy opportunities and risks

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Economic crisis	Risk: High R&D expenditure targets have been set; yet the weak budgetary planning and execution, with frequent in-year rectifications accentuated by the world economic crisis can jeopardise the targets.
Low Private R&D expenditure. Low innovation culture. Lack of tradition of collaboration public-private in R&D activities	Opportunities: Set of direct measures, complemented by tax incentives are implemented to support R&D expenditure in innovative enterprise, to increase the R&D public- private collaboration. RISKS: Low technologies, showing a weak demand for knowledge Lack of response from the private sector, that may continue to hesitate to increase their competitiveness based on RDI activities
The national industry and FDI pattern	RISKS Privatisation-led FDI inflow is over. Unless other factors will trigger the FDI inflow, this will seriously decline in the next years. Weak demand for knowledge from industry. Lack of highly skilled labour force available due do inefficient reform of HE system and large migration
Weak public administration. Lack of awareness and transparency of public procurement. Inefficient judiciary system. Low business infrastructure.	RISKS Some progress has taken place, yet progress remains slow. The implementation is supported by a complex administrative system which has not been reformed, preserving unfavourable institutional habits.

4 Contribution of national policy mixes to the realisation of the European Research Area

ERAWATCH country reports 2008 provided a succinct and concise analysis of the ERA dimension in the national R&D system of the country. In this Chapter we are developing further this analysis and provide a more thorough discussion of the national contributions to the realisation of the European Research Area (ERA). An important background policy document for the definition of ERA policies is the Green paper on ERA[47] comprising six policy dimensions, the so-called six pillars of ERA. Based on this document, in the following we are investigating the main national policy activities contributing to the following dimensions/pillars of ERA:

- *Developing a European labour market of researchers facilitating mobility and promoting researcher careers*
- *Building world-class infrastructures accessible to research teams from across Europe and the world*
- *Modernising research organisations, in particular universities, with the aim to promote scientific excellence and effective knowledge sharing*
- *Opening up and co-ordination of national research programmes*

In the ERA dimension the wider context of internationalization of R&D policies is also an issue related to all ERA policy pillars and is normally present in the dynamics of national ERA-relevant policies in many countries.

4.1 Towards a European labour market for researchers

National context

Due to chronic underinvestment and the low attractiveness of the research career, Romania faced a drastic (~51%) quantitative and qualitative loss of the human resources between 1990 and 2002 (Sandu et al, 2008). Starting 2002, a slight increase has been measured, yet the figures remain under the 1990 level. In 2007, the number of researchers holding a PhD title and working in R&D activities increased to 14228, with a total of FTE employed of 28977. At present, ~50% of the research staff is over 45 years old (INSSE, 2008b). The employment in medium and high-tech manufacturing lags about 20% behind the EU average. The increase of the total number of academic staff from 27959 in 2000, to 31964 in 2007 was triggered by the much higher increase of number of students enrolled in both public and private HEIs (within the same time frame, from 521483 to 896258). Consequently, during this period (2000-2007), the number of students per academic staff has increased from 21 to 28. Worrisome can be also the high percentage of administrative staff relative to the total staff employed in HEIs (researchers&academics count to 56.3% of total employees in HEIs) (MERY, 2008). The Romanian HE system has failed so far to be restructured in a coherent, consistent manner. HEIs, especially private ones, have responded mainly to the immediate demand of the target population, without taking into consideration the medium and long-term economic evolutions. As a consequence, HE has faced a significant increase of the number of students in some fields (i.e. economics, law etc) and particularly in private universities, that triggered the rapid and artificial raise of faculties in these sectors, showing very low scientific performance. For example, the Academy of Economic Studies, the main public university in the economic field, with a number of 847 academic staff published in 2007 only seven ISI papers (Ad-Astra, 2007). The scientific output from all private universities is virtually zero (i.e. the University Spiru Haret, Bucharest with 962

[47] Commission of the European Communities: Green paper: The European Research Area: New perspectives. Brussels 4.4.2007, COM(2007) 161final (see http://ec.europa.eu/research/era/pdf/era_gp_final_en.pdf).

academic staff published only one ISI paper in 2007). Quality suffering as the educational system expands and restructures to comply to Bologna system is a syndrome of the current HE system (SAR, 2007). It is worrisome that none of the Romanian University is in top 500 Shanghai, while national PhD students and researchers have excellent results when performing research abroad.

Although difficult to assess, the magnitude of the brain drain and more specifically of the emigration of scientists and engineers (S&E) accounts to ~15000 Romanian researchers with ISI publications working abroad. According to the EC survey, Romania has one of the highest intra-EU net losses[48] in absolute terms, accounting to 8.9% of their number of doctoral candidates (Moguerou and Di Pietrogiacomo, 2008). It also accounts as one of the European countries with the highest number of students in USA, showing a positive increase over time (3217 in 2004, 3225 in 2005/2006). 1951 were graduate students (Master and PhD level), counting as the fourth highest number of European nationals in American universities (after UK, Germany and France). While the top 4th position was maintained in 2006/2007, the overall numbers of graduates and scholars has slightly decreased, likely triggered by the early crisis effects in USA and the new opportunities raised in Europe by FP7 (Institute of International Education, Open Doors 2006, 2007). Given that these students generally do not return to Romania these figures can be included almost as such into the brain drain total. Compared to the size of the local research workforce, Romania has the 4th highest position among EU countries in terms of scholars in USA (after Cyprus, Ireland, Netherlands) (Moguerou and Di Pietrogiacomo, 2008). Empirical proofs further show that many talented scientists and engineers have been misused or underutilised when they returned, either because of inappropriate research facilities for the research field in which they performed abroad or rigid promotion systems. The main push/pull factors determining the migration of Romanian researchers are: job and career opportunities, a search for a positive working, political and social environment, mistrust in the political class and the low life quality, summarised as "*better brain drain than brain waste"* (Ferro A, 2004).

In the academic system and PROs, within the frame of the inherited legislation, all the positions used to be permanent. Currently, temporary post-doctorate positions can be offered in the frame of projects funded within NPRD 2. Although no official statistic data are available regarding the relative weight of permanent versus temporary positions, the former counts to the highest proportion. Advancement in academic career is based on positions availability generated by peer retirement rather than performance, consequently implying many years before talented researchers are able to become independent scientists in their own right.

The salary level for academics and researchers is well below of the EU average, Romania being ranked second the lowest, higher only to Bulgaria and below similar level positions in national private sectors and other publically financed jobs (EC, 2007). In September 2008, the Parliament approved the Law 10/2008 that stipulates the increase of teachers' wages (including academic staff) by 50%. The continuous structural changes of the education system since communism's collapse and the high disappointment of the teaching staff have seriously affected the quality of the education system.[49] Although criticised as having the potential to trigger budget

[48] The intra-EU net gains have been calculated as the differences between the number of doctoral candidates of EU nationality in the reporting country and the number of its citizens' doctoral candidates in the other MS

[49] At the 2006 PISA assessments, the Romanian students, irrespective of their residence environment obtained scores lower than those in 2001 for all the subjects tested and below the international average (MERY, 2008).

deficit and inflation, public debates support this measure as means of achieving a better quality of education if implemented in a flexible manner that would encourage the performance. In the context of the economic crisis and recent government reshuffle (November 2008), the law, although approved, has been under stringent political debate, subsequently followed by Union and Ministry negotiation.

4.1.1 Policies for opening up the national labour market for researchers

Doctoral programmes

The Law 288/2004 giving the general frame for restructured HEIs and the subsequent Government Decision 567/2005 create the legislative framework for the implementation of the restructured doctoral programmes. Two types of doctoral programmes became operative: scientific and professional doctorate, with a 3 years length corresponding to 180 ECTS[50] credits. The doctoral programmes are already defined in terms of knowledge, competences and abilities. The Law 87/2006 gives the provisions for a quality assurance system in education and for the establishment of the Romanian Agency for Quality Assurance in Higher Education (ARACIS). Being established after the Ministerial Summit in Bergen, ARACIS has based its work on the European Standards and Guidelines for Quality Assurance in the EHEA' and is a candidate member of the European Association for Quality Assurance in Higher Education. Compliance to quality criteria, in terms of proven capacity to provide an integrated environment for advanced education and research at national and international level, is assured by periodic evaluation of the HEIs approved by MERI to organise doctoral programmes. The doctoral programmes are assessed every 5 years for each field under criteria and methodologies approved by MERI. On the basis of this evaluation, the National Council for the Recognition of Diplomas (NCRED), decides to retain or retire the right of the HEIs to organise PhD programmes. Legal provisions exist for doctoral programmes in international co-supervision, the PhD student performing his activity under simultaneous supervision of a national and a foreign supervisor, on the grounds of written agreement between the two institutions. The MERY Order 3861/2005 introduced the post-doctorate programmes consisting of two-year advanced research programmes aimed to train outstanding researchers.

The latest official data regarding the inflow of foreign students indicate in 2006 a 1.4% level of participation of foreign students relative to the total of tertiary students (ISCED level 5 and 6), compared to 2.8% in 2005 (EC, 2008). In 2005, the number of doctoral candidates in Romania holding the citizenship of a MS, was counting to less than 2.5%, compared to 16% of Romanian doctoral students in other EU countries. According to same source, in 2005, Romania with a figure of 8.9% is the 2nd among the countries with the highest intra-EU PhD net loss (after Italy with 11.8%).

International recruitment

The Romanian Constitution, the Law of Education, 84/1995[51] and the "Law 128/1997 regarding the status of teaching staff"[52] and their subsequent revisions and

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The PIRLS evaluation indicates a significant 22 points decrease in 2006 compared to 2001, the 2006 evaluation placing Romania below the OECD average (MERY 2008).

[50] ECTS - European Credit Transfer System

[51] Law of Education, no. 84/1995 stipulates regulation regarding the categories of teaching staff, specific demands of the professional training, the staff selection and recruiting

[52] The Law no128/1997 regarding the status of teaching staff defines in details the positions, skills, duties, obligations and rights of teaching staff, necessary qualifications for the teaching positions, the recruitment procedure and assessments of the teaching staff

amendments provide the legislative framework for the education system. Given that the laws regarding education are dated before the adhesion to EU, although alterations are provided by various amendments and revisions, they do not fully reflect the new societal demands, particularly compliance to the new European dimension. This and associated practices still hinders or prevent international competition-based recruitment in the public sector.[53] In Romania researchers and academic staff have public servant status. Accordingly, the announcement and recruitment procedure follow the national legislation, available positions being advertised in the National Official Monitor. The competition for the first three steps in academic careers apart of '*dossier de candidature*' requires examination on the site, while for the higher positions, examination is required only for applicants external to the academic system. For all the positions, the '*dossier de candidature*' must contain all the diploma studies recognized by NCRED, which takes decisions on recognition and settles conditions of equivalence. Although, Romania signed and ratified the Lisbon Convention on the Recognition of Qualifications by the Law 172/1998, the recognition of foreign diploma follows a specific route, that '*per se'* may be difficult and time-consuming.[54] The academic and research positions remain filled by national and in most cases, internal staff. In 2004, all the researchers in PROs and academic sector were Romanians (Moguerou and Di Pietrogiacomo, 2008).

Bachelor courses taught in English are nowadays rare in Romania, actually mostly disappearing in the Bologna reform implementation process. Yet this may be a prerequisite if the intention is to attract foreign students and professors, the experience of other countries suggesting that 25% to 50% of Bachelor and Master courses could be offered in English within ten years. Such a shift could facilitate the openness of the national system.

At present, rigid compensation, recruitment and promotion procedures, underlined by overall national context in terms of research conditions and quality of life, make difficult for universities and PROs to compete in an international research market.

Mobility

Efforts are taken at policy level to promote the short-term outward mobility, especially for PhD students. Within NPRDI 2, Ideas Programme supports short mobility stays. Funding for participation of national researchers to international conferences is supported through "Projects supporting researchers mobility", while through Exploratory Workshop Programme mobility expenses for foreign invited key speakers can be covered. Considering the specificity of the inherited R&D national system, less attractive in the international landscape, a more realistic national policy measure to support the brain gain was to provide specific instruments that encourage the return of researchers from Romanian Diaspora (*return option*). The Programmes "Research projects stimulating the return of researchers" and "Complex research project for reintegration of researchers" are aimed to stimulate the return of Romanian researchers from abroad. Although the nationality is not explicitly stated as an eligibility condition, both programmes are aimed to stimulate the *"scientific excellence in Romanian research, by assuring adequate conditions to Romanian researchers working abroad, having significant results in science and international experience*". Since 2007, ~40 Romanian researchers working abroad have returned

[53] Art. 55, paragraph (8) of Law of Education stipulates that "*All the academic positions can be filled only by Romanian citizens. By exception, these positions can be occupied on the ground of temporary contracts by foreigners, as associated staff.*"

[54] Recognition of PhD diploma requires a maximum 30 pages summary of the PhD thesis in Romanian language

to Romania through these recently implemented funding instruments. The remote mobilization of the national researchers working abroad (so called "*Diaspora option")* was also considered. In 2008, the first National Conference of Romanian Diaspora was organised with the aim to extend the dialogue and the co-operation between researchers working in Romania and those working abroad.

In the framework of the Human Resources Programme, there are currently 704 projects running for young PhDs. In 2007/2008, 75 students were the beneficiaries of fellowships abroad financed by the Romanian Government, while other 80 Romanians were the beneficiaries of such grants financed by foreign governments and institutions within the frame of bilateral agreements (MERY, 2008). The latest official data regarding the students' flows indicate that in Romania in 2006, the number of foreign students accounted to 1.4% of the total of tertiary students (ISCED level 5 and 6), compared to 2.8% in 2005 (EC, 2008a). Short stays of foreign researchers are supported through bilateral programmes as detailed in section 4.4. In 2007, mobility of 195 foreign researchers and 184 Romanian researchers was supported through Bilateral Cooperation Projects operative with 11 countries. The highest exchange was with France within the program Brancusi (Hubert Curien), followed by Hungary.

Although at logistics level the Romanian Mobility Centres Network (RoMob), part of the European Network of Mobility Centres, was set-up in order to provide customised assistance to researchers, empirical evidence shows that the low usage of this tool prevents achieving its aim. Only 40 research organisations (individual departments within universities are counted) are registered, while on the *Romanian Mobility Portal* only very few (~3) positions, mainly those funded through EC programmes are advertised (EURAXESS, 2009).

4.1.2 Policies enhancing the attractiveness of research careers

Remuneration policies

Some financial incentives at university level do exist to encourage scientific performance, nevertheless with serious budgetary constraints, the payment schemes remaining mainly rigid. At present, public funding appropriations for universities are mainly determined by the number of students, rather than by the number of academic staff or the quality of their performance. Nevertheless, while mainly the basic salaries remain constrained to rigid regulations and budget, academic staff and researchers from PROs have the right to withdraw funds from research projects as personal income (up to ~60% of the total budget of the project).[55] The maximum level of the income that researchers can earn from research activities performed under NRPDI 2 Programmes has increased double fold compared to the limit previously existing in NRPDI 1. Also, a special scheme under NPRDI 2, Human Resources, "Awards for scientific excellence" was designed to offer financial bonuses for Romanian researchers that publish in ISI journals or are the authors of national and international patents. These financial incentives are aimed to encourage scientific excellence. However frail, they can be used as the basis to be further build upon for increasing attractiveness of scientific careers, both for nationals and foreigners through flexible financial arrangements rewarding scientific excellence.

[55] Up to €4300

Uptake of the Charter of Researchers

Two institutions (The National R&D Institute for Textile and Leather and The University of Medicine and Pharmacy "Victor Babes", Timisoara) accounting to ~ 0.25 % of the total number of Romanian research institutes have adopted the 2005 European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers (EURAXESS, 2009). Some of the recommendations of the European Charter that may preclude its adaptation at a larger scale include avoidance of excessive teaching responsibilities that may inhibit researchers from carrying out their research activities, avoidance of penalization of career breaks, variations in the chronological order of CVs, recognition of mobility experience, full transparency of recruitment and promotion**.** Complemented also by the rigid promotion system, the high discrepancy between the salaries for older professors and any other positions in the academic hierarchy, resulting in professors' common request for prolonging their careers above retirement age and consequent blockage of these positions, all these reasons have led to the ageing of the academic staff and the generation of a *"closed academic system*" (SAR,2007). This warning coming from the academic society has been empirical shown by a monitoring project of Romanian HEIs that highlighted the lack of transparency in promotion and recruitment, human resources practices that preclude access of younger academic staff with visible scientific results to the positions of reader/ professor (SAR, 2008).

There is no evidence of specific measures taken at national level to support the adoption of the European Charter for Researchers at a larger scale.

Researcher-friendly social security and pension systems

EC Researchers. Since accession to EU, all the EC regulations must be implemented at national level, so in terms of social security, Council Regulation (EEC) No. 1408/71 on the application of social security schemes to employed persons, to self-employed persons and to members of their families moving within the Community provides the legal framework for social security for foreigners working in Romania. The research grants are regulated normally by same rules as the work contracts and automatically a person employed under such contract becomes liable to social and health insurance taxes and implicitly the recipient of such assistance. The guaranteed social protection includes: disease, maternity and unemployment subsidy, disability protection, family charges for families with many children and no work places and pension. Employment is made by signing a labour contract obeying the legal provisions of the Romanian Labour Code. Each employee contributes towards the national social security fund according to the respective income. Starting 2007, all contributors under age of 35 must contribute also to private pension funds. Under Article 17 of Regulation 1408/71, granting exceptions to the rules for employed persons with special knowledge and skills, researchers can benefit from the special provisions on social security within the frame of bilateral agreements undersigned by Romania and other countries. Recognised as a serious common difficulty all over Europe, the lack of information on EU rules concerning the coordination of social security systems reduces the share of researchers who can benefit from them, while, particularly in Romania's case, the lack of similar precedents may create further confusion. Romania has signed agreements on social security with the following EU countries: Czech Republic and Slovakia[56], Holland, France and Hungary with no

[56] Under the same agreement undersigned by Republic of Czechoslovakia

specific provisions for researchers.[57] The agreement with Luxembourg, art.14 stipulates that exceptions can be provided for specific professional groups, nevertheless no explicit specification to researchers is included. Only the agreement with Germany provides clear incentives for exceptions for employees in science, research, education and culture fields.

Researchers from third countries. For foreigners that need a visa the Romanian visa is granted by its diplomatic missions and consulates from abroad, after getting the approval from the Ministry of Foreign Affairs. Specific provisions for researchers have been provided through the "scientific visa" package adopted by Order 2414/2007. According to this order any R&D Institution that wants to receive a researcher from a third country to undertake R&D activities for a period longer than 3 months must apply for approval from NASR, the document being valid 6 months from the moment of validation. Only R&D institutions accredited as such by NASR have the right to apply for scientific visa.

Promotion of women

With a human resources employed in an S&T occupation as professionals and technicians (HRSTO), accounting to 20.5% of total employment, lower than the 31.3% EU-27 average, Romania is above the EU average when discussing the female share. With 51.8% female share of total number of HRSTE[58] in science, mathematics and computing and 31.5% in engineering, manufacturing and construction, Romania is well above the EU27 levels of 29.5%, respectively 20.4% (EUROSTAT, 2008)

Current national legislation regarding 'parental' leave reinforces the gender equality: mothers or fathers are entitled to up two years paid break after the birth of a child, while the work reintegration after parental leave is guaranteed by law. In the frame of newly doctoral and post-doctoral programmes, it is not clear how researchers eligible for parental leave while working within a project funded under strict time and budget constraints will be able to receive an extension of the contract. The public system lacks sufficient care facilities for preschool age, while the public supplies for after school are mainly absent. Although Romania has the benefit of good inherited political tradition regarding access of women to S&T fields and the legislative framework to ensure the gender equality, the cultural traditional gender roles are manifested by the facts that women take substantially more parental leave. This is bounced to affect the progression of women in career, rather than their access in R&D activities. Since rigid assessments are in place for career progression, based on 'absolute performance' (in science fields, the Hirsch index is the main assessment criterion for career progression) rather than on 'performance relative to opportunity', women who have taken time out for child care, and generally career breaks are penalized in career progression. This is reflected by the time evolution trend of salaries for female versus male researchers. The difference of female researchers' salaries compared to their male counterparts in the same group of experience changes from +33% in the group 0-7 years experience, to -16% for experience above 15 years (EC, 2007).

[57] There is no specific legal instrument applicable or in progress of negotiation with the following EU countries: Belgium, Cyprus, Denmark, Estonia, Finland, Latonia, Lithuania, Malta, UK, Poland, Portugal, Slovenia, and Sweden. A bilateral agreement regarding social assistance with Austria is in process of being approved, while with Italy in negotiation process.

[58] HRSTE Human Resources in Science and Technology (Education) who successfully completed education at the third level in an S&T field of study

4.2 Governing research infrastructures

National RIs context and strategy

Only a small fraction of the Romanian RIs can be regarded as large RIs, mainly in physics (see Annex 1), while due to chronic R&D underinvestment, large RIs that can be regarded as "of international interest" are mainly absent. In response to this weakness and to the European Strategic Forum for the Research Infrastructures (ESFRI), the RCRI delivered the "national road map for RIs" which identifies the national high-priority infrastructure objectives and the associated financial efforts. It was decided that the National Road Map should consider only RIs projects that requires funds higher than €0.6m and a stable institutional frame given the long development period. It envisaged the development of 19 new research centres in 10 S&T fields considered national priorities.

1. Technology of Information and Communication (6 RIs with a total of €51.95m),
2. Energy (1 RI with €3m);
3. Environment (2 RIs, €54m),
4. Physics (1 RI, €20m);
5. Health (2 RIs with €69m),
6. Agriculture, food safety and security (2 RIs with €10.7m),
7. Biotechnologies, biology and genetics (1 RI, *€20m),*
8. Innovative materials, processes and products (2 RIs, €5.5m)
9. Space and security (1 RI, €12m),
10. Social and economic and humanities research (1 RI, €20m).

Relevance for the current priorities and tendencies featured by ERA was also taken into account, the highest proportion of funds targeting Health, Environment and ICT.[59]

As previously mentioned (section 2.3.3) a different category to the RIs identified as priorities in a top-down manner are those in fields with special potential, identified as such by scientific and business communities (bottom–up approach). The instruments supporting the development of these RIs are "Capacities Programme, module I" and SOP-IEC, priority 2.2.1: Development of R&D infrastructures. The multi-annual 2007-2013 budget for this programme is 2025 millions RON (~€530m).

In 2008, the GBAORD increased significantly and accordingly the funds allotted to RIs. This impetuous was mainly generated by Romania's goal to achieve 1% public R&D expenditure by 2010. During the year 2007, the budget allocated by NASR for RIs increased double fold compared to 2006.

Participation in inter-governmental RIs

In particular cases, given the significant resources that such facilities require, Romania considered more efficient to use intergovernmental RIs rather than engaging independently, at national level in similar directions. Since the concept of RI is best defined and widespread in physics, but also most costly, Romania has considered more efficient the use of such infrastructures. In 1991, Romania has

[59] According to the CRIC report, some of the objectives targeting ERA are: creating the premises necessary for national participation in the trans-European projects in data communications; facilitation of cross-borders scientific cooperation and creation of research consortia on various fields; inclusion of the national libraries system in the "European Digital Library"; development of a research platform for ecological fuels in concordance with European and national energy policies; compliance to the new European Directive for Soil Protection; implementation of the NATO priorities in the security and defence field; participation in fight against the proliferation of forged goods and the illegal trade with patrimony goods at the border between the community and extra-community space.

signed a first agreement with European Organization for Nuclear Research (CERN) and in 2002, the Agreement of Cooperation.[60] In 2008, Romania has been formally accepted as a Candidate for Accession to CERN membership, which will be phased in over a five-years period during which the country's contributions will ramp up to normal CERN member states levels, in parallel with Romanian participation in CERN projects. Through Capacities Programme, (Module III) yearly RON 4.5m(€1.1m) are alloted for the participation of Romanian researchers in CERN projects. Although not a full member of ESA, in 2006 Romania strengthened its relations with ESA by signing the European Cooperating State Agreement, becoming the third European country to join this status. According to the Law of the Cooperation with ESA, in the period 2007-2011, the committed Romanian financial contribution to ESA is €10m.

Romania participates on the basis of the signed Charter in JINR - Joint Institute for Nuclear Research, Dubna in all forms of activities (Law 49/1994). Romania also participates in the International Centre for Genetics Engineering and Biotechnology, Trieste, the Commission of United Nations for Science and Technology, Genève, the Treaty of Antarctica (UNESCO).

Participation in ESFRI

Romania currently participates in 9 of the ESFRI 36 projects in the following fields: Social Human Science (CESSDA, CLARIN) Environment (LIFEWATCH, EUROPOLAR and ERICON), Life and biomedical sciences (Biobanking and BioMolecular Resources Research Infrastructures) and Astronomy, astrophysics and particles physics (SPIRAL2, KM 3NeT (Cubic Kilometre Neutrino Telescope, FAIR, ELI). Romania's participation as founding member to the GSI-FAIR project (Facility for Ion and Antiproton Research)[61] in Darmstadt, Germany is to be highlighted. The possibility to locate Extreme Light Infrastructure (ELI) [62] in Romania is currently taken into account (NRP 2008).

Openness of RIs

Foreign access in existing national RIs is granted within various research programmes and bilateral cooperations. All the RIs envisaged by CRIC are national through funding and coordination, but aimed to be internationally opened.

4.3 Research organisations

Assessment of the progress of educational reforms in terms of broader autonomy in research

In principle, the University autonomy is guaranteed by the provisions of Romanian Constitution (art.32 (6)) and those of the Education of Law (Section 7), with all the later amendments and additions. The whole set of rights and obligations as well as the norms underlying the life of the university community are to be found in the **University Charta** adopted by the individual academic senates. As commonly defined by the University Charta, the autonomy focuses on '*leadership, structure, management, didactic activity, scientific research, administration and financing and relies on the right of the university community to its own leadership/self-governing and on its right to benefit from academic freedom without any political or religious*

[60] In the period 2004-2008, the Institute of Nuclear Physics Horia Hulubei (IFIN) as main Romanian participant in CERN projects contributed with €4.3m for collaborative research at CERN (OST, 2008).
[61] NASR and National Institute of Physics and Nuclear Engineering are the Romanian teams part of the Consortium
[62] National Institute of Laser, Plasma and Radiation Physics (INFLPR) - Romania

intrusion'. The universities have full freedom to manage their research budget, to autonomously design research agendas and topics of research specialisation. Although designed individually, analysis of the University Charta of the main national universities shows that they are similar content wise, prevailing uniformity in the definition of the academic autonomy, governance and mission (all HEIs are self defined as institutions of education and research).[63] This is mainly grounded in the current legislation which guarantees the academic autonomy, but also defines its boundary. The legal frame established by active relevant laws may preclude a real academic autonomy: there is still little freedom in designing human resources policies in terms of hiring, progression, payment and number of teaching hours. While the competition criteria for the first hierarchical academic and research steps are decided internally, for the titles of reader and professor the approval by the Faculty and University Senate, must be subsequently followed by the approval given by the National Commissions that function under MERI. The evaluation of the dossier is performed against national criteria for each grade, with sometimes significant tailoring on the field. National rules with no freedom of alteration at individual university level are applied for professors entitled to supervise PhD students.[64]

Academic governing structures

The elections of the academic governing structures are conducted on the base of regulations of individual University Charta, but within the general legal frame established by the Law of Education, the Law regarding the status of teaching staff and their amendments and the MERY Order 2538/2007. Article 3 of the later order stipulates that "*for governing structures and positions can candidate only academic and research staff holding a permanent contract in that particular HEI.*" The HEIs, with some minor variations from one institution to another, are governed by the Senate, who elects and is chaired by the Rector (Chancellor). The Rector must be confirmed by MERI order.

Academic funding

Block funding for universities is provided only for **education activities,** no institutional funds being allocated directly to HEIs for research activities. The block funds are calculated according to the number of equivalent students and to other quality indices set by MERI, mainly through proposals made by the National Financing Council for Higher Education. The quality quota in the financing formula increased to 30% and 13 quality indicators in 2008, the other part (70%) being determined by the number of equivalent students. Although some of the quality indicators are determined by the quality of the training and research delivered by HEIs, the number of equivalent students is dominant in funds allocation. The funds coming from the state budget represent 65-80% of the whole budget, the rest of funds coming from fees, research contracts, services and other types of activities. In public HEIs, public revenue is supplemented to a small extent by private revenue (i.e. tuition fees charged for certain groups of students, such as limited number of self-funded student positions as approved by MERI, lifelong learning etc). Private universities are self-funded, only after accreditation being entitled to receive funds from the state budget.

[63] As shown by the University Charta of the main, traditional national universities: Charta of University of Bucharest, Polytechnics University Bucharest, Cluj, Iasi, Timisoara.
[64] In Romania, only academics having the position of professor have the right to supervise PhD.

In 2007, the source distribution of the **R&D budget** managed by the HE sector was the following: 85.6% from the state budget, 5.6% from the business sector, 5.5% from abroad and 3.3% self-funding (INSSE data). Public funds for R&D activities are channelled to HE solely via competitions, no institutional budgets being allotted from the aggregate R&D public budget. Since 2006, research activity became compulsory for university accreditation (Government Decision 1418/2006). The autonomy in conducting research is highlighted by the high number of proposals within NRPDI 2 awarded to universities.[65] Many of the projects are bottom-up, having research agendas designed by the researchers themselves.

Romanian universities are engaged to some, however limited, European and international networks and partnerships. Grass-route international collaborative initiatives are mainly possible within the frame of national or European research and educational programmes that promote such collaboration since the universities funds are still scarce. Little freedom outside these mechanisms is possible due to budgetary constraints, yet not due to restricted autonomy. In the frame of francophone cooperation, there are around 600 agreements between Romanian and French universities, the French Embassy contributing annually to 120 PhD and Master fellowships.

4.4 Opening up national research programmes

Access of non-nationals to national R&D programmes

Most of the programmes under Ideas and Human resources (NPRDI 2) do not stipulate the nationality as eligibility criterion, but states that the main applicant must have a full time labour contract in a Romanian R&D organisation registered and validated in the Register of Potential Contractors and framed in the research definition, pursuant to the Community Framework for State Aid. The other NPRDI 2 programmes[66] clearly stipulate that the candidate must be a Romanian entity with legal R&D identity. Some NPRDI 2 programmes, as detailed in section 4.1.1, support specialists working abroad. Under SOP-IEC, PA 2 the eligibility for the programme "R&D Projects of high scientific level involving foreign specialists" (launched in March 2009) is conditioned by the participation of a *foreign specialist*[67] as a project director.

Overall there is no clear evidence that programmes/measures are open for foreign participation when assessing the eligibility criteria of the main applicant, yet no nationality restrictions are ruled for the composition of the research teams. Measures have been implemented with the explicit aim to encourage/fund international R&D collaboration. Significant barriers to international opening are grounded in the national context. On a fundamental level, the aim of a national research policy funded by national funds is first and foremost to improve the national scientific and technological capacities. This holds especially true for Romania, where chronic underinvestment drastically has affected over years the science base in terms of human resources and research infrastructure. Romania has firstly to aim to address these significant national drawbacks in order to be able to compete with fair chances in internationally open competitions, to be able to be engaged in durable

[65] Within NRPDI 2, in 2008, ~250 out of 605 funded projects under "Partnerships in priority S&T domains" were awarded to universities, and 18 out 52 projects under Capacities I and II programmes. The highest proportion of projects funded under Ideas programme was awarded to universities, the rest of funds going mainly to PROs.

[66] "Partnerships in priority S&T domains, Capacities and Innovation

[67] Foreign specialist is defined as any person who has minimum 5 years research experience and minimum 3 years experience abroad out of the last 5 years (including PhD studies)

partnerships. In this context, the international co-operation is used as means of improving national scientific excellence.

ERA-NET participation

The rationale for Romania's participation in ERA-NETs is part of a much broader strategy, ERA-NETs being seen as a practical instrument to coordinate national policy with ERA policy and thus foster European integration. At organisational level, a secondary rationale was to establish networks and build new relationships with funders from other countries. Romania participates in 13 FP7 ERA-NETs, in the fields of environment, energy, ITC, health, biotechnologies, space and social-economic and humanities research. The higher participation in FP6 ERA-nets was in fields of Environment & Energy, Life Sciences, Industrial Technologies and SMEs, broadly in line with the budget allocated to national programmes in these thematic areas (see Annex 4). During FP6, in terms of contribution to joint calls or programmes, Romania with €2m contribution was the second contributor after Poland among the EU12 Member states. Almost all of Romanian joint call contributions were channelled through virtual common pots and above 75% of Romanian contributions were made in the Industrial Technologies and SMEs theme (OST, 2008). By participation to these projects, Romania ensures the coordination of the national RDI programmes with those of other Member States, the integration of Romanian science community into the ERA, more opportunities for collaborative research and the enhancement of the visibility of Romanian research teams.

Joint Technology Initiatives

Romania supports also the development of new forms of public-private partnership in research, represented by the technologic platforms as well as by the joint technology initiatives (JTIs). During the period 2007-2008, Romania registered as member to four of the six approved JTIs: ARTEMIS (integrated informatics systems), ENIAC (nanoelectronics), IMI (innovative medicines) and CLEAN SKY (aeronautics) (NRP 2008).

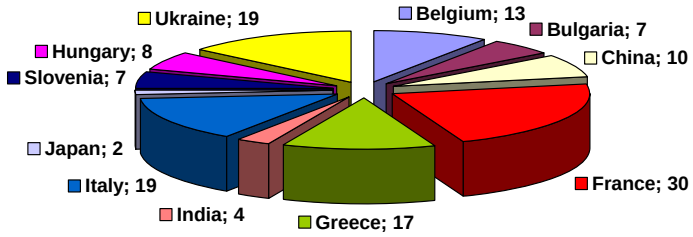
Collaboration within EC funded projects

In the framework of FP6 and FP6-Euratom, Romania participated with a total of 541 projects, summing up a EC contribution of about €57m. The highest participation in terms of funds is in the field of ICT (93 participants and €10.9m), followed by Nanotechnology, Nanosciences and Advanced Materials (€9.6m, 72 participants) and Sustainable Development and Climatic Changes (€7.7m and 102 participants). (NASR, 2008).

In 2007-2008, within FP7, Romanian participants submitted 772 projects applications, out of which, 98 were selected for funding, involving 119 Romanian participants and €14.5m. The fields with highest number of submitted applications were the fields of ICT (counting to ~25%) and environment, with ~14% of total submitted projects. The fields with the best rate of success were: the research infrastructures (68.18%) and space (40.91%). The Romanian participation in EUREKA (69 projects, out of which 35 are active) and COST (92 projects) is concentrated in environment protection, new materials and ICT. Capacities, module III and IV support financially the participation of Romanian R&D entities in international projects and within international S&D organisms (NRP 2008).

Bilateral agreements

Based on intergovernmental agreements, Romania jointly manages S&T programmes with countries all over the world at a rate of about 440 projects per year. Over 40% of them are carried out in Europe and are aimed to uphold the country's future participation in EU FPs. Romania has signed bilateral agreements for S&T cooperation with 60 countries. Under the legal provisions of these agreements, in 2007, 134 projects with 11 countries were undertaken within the frame of bilateral cooperation programmes (NASR,2007). These joint research projects are aimed to intensify bilateral S&T cooperation activities by mainly supporting the scientists' mobility. The country distribution of the bilateral projects undertaken in 2007 is represented in the diagram, the highest share of project being in the field of Advanced Materials, Micro and Nano-technologies (33), Engineering Sciences (30) and Environment (22).[68] The universities are the most active in bilateral co-operation, 56% of such projects involving Romanian universities. The next participation rate comes from PROs under the coordination of NASR (38%) and PROs administrated by the Romanian Academy (16%). Currently, bilateral cooperation programmes exist with 19 countries, belonging to EU (Austria, Belgium-Flanders and Wallonia regions, Bulgaria, Cyprus, France, Germany, Greece, Italy, UK, Slovenia, Hungary), associated countries (Turkey) and rest of the world (South Africa, Ukraine, India, Japan, China, South Korea, USA). Recently, on the basis of the agreement undersigned by NURC and National Science Foundation (NSF), USA, the Romanian scientific community can participate in the "Materials World Network", that supports international cooperation in the field of materials physics and technology. In conformity with the provisions of the bilateral agreements, calls for proposals are launched simultaneously in Romania and the partner country. The proposals are evaluated independently in the two countries against same evaluation criteria. For the projects approved for funding, corresponding agencies/ministries support the mobility costs. The bilateral cooperation projects complement research activities already funded through one of the NRPDI 2 programmes.



The impact of the bilateral agreements is noted in the change of the ten top countries with which Romanian researchers have co-publications. In 2006 (latest available data), 53.5% (compared to 48.6 % in 2001) of the Romanian publications had an international co-author. In terms of co-publications, France has the leading place (22.7%), followed by Germany (20.6%) and USA (16%). While in 2006 same countries as in 2001 were in top-five, Russia is not among the top-ten, and two countries, Japan and Poland raised in the top (OST, 2008). While the co-publication leading place of France can be seen a result of a policy action, the top positions of Germany and USA appear to be a result of researchers' individual efforts and preferences in undertaking research fellowships in these countries. As a member of the International Francophone Organisation, Romania enjoys a preferential research collaboration framework with France, articulated on two axes: individual mobility research grant and collaborative projects under the bilateral cooperation programme "Hubert Curien" (ex-programme Brancusi).

[68] Basic and social sciences (16), Agriculture and food (12 projects), Biotechnology (5), ICT (4), Life and Health (12).

4.5 National ERA-related policies - a summary

The European dimension and the importance of international/European co-operation and partnership are highly acknowledged in the current national research policy. It is apparent from the NSRDI that the strategy visions the integration within ERA. Nevertheless, the assessment of the implementation shows that a more systemic and coherent approach is necessary in order to make the objectives reachable.

The National Pact for Education and Research, established in March 2008 by all political parties, Romanian Academy, union trades, students organisations and various other non-governmental organisations delivered an integrated vision 'The National Strategy 'Education and Research for a society of Knowledge.' This strategy targets some of the weaknesses identified above. Some highlights of the recommendations promoted by this strategy, with the corresponding time planning are: classification of HEIs according to their performance and concentration of resources in the top universities (2009-2010); full academic autonomy in terms of human resources policies (2009-2010); grants portability (2009-2010); new governing academic structures involving the entrepreneurial managerial model and provisions for training qualified managers for HEI (2009-2012); quality and relevance of higher education (2009-2012); restructure of the RDI system. Nevertheless, it remains open for assessment if this strategy will be more than politics rhetoric. Various amendments of the Law of Education have tried to address the new societal demands. The proposal of the Law of Education since December 2007 submitted for public consultation on MERY website responds to many of deficiencies that may preclude attaining a real European dimension: it provides the legal frame for the recruitment of foreigners for permanent position and academic autonomy of designing human resources policy.

Table 9: Importance of the ERA pillars in the ERA policy mix and key characteristics

	Short assessment of its importance in the ERA policy mix	Key characteristics of policies
Labour markets for research	Important at policy level, but implementation lacks coherent and systemic approach	• Measures were taken to support mobility, reward scientific performance and attract young graduates into research careers. However, measures were taken in isolation: increase of public PhD stipends led to the situation in which these are higher than public wages for well established academic & researchers holding a PhD. • The labour market for researchers remains unattractive to foreigners, many nationals choosing options available abroad. • Outdated legal frame and well established human resources practices still hinder or prevent international competition-based recruitment in the public sector
Governing research infrastructures	Important	• First call for large RIs was launched in 2008. The National Roadmap is complementary to ESFRI.
Autonomy of research institutions	Increasingly important	• The legal frame established by active relevant laws guarantees the academic autonomy, but also defines its boundary. There is little freedom in designing human resources policies in terms of hiring, progression, payment and number of teaching hours.
Opening up of national research programmes	Increasingly important	• Strongly national with regards the main applicant, yet no nationality restrictions are ruled for the composition of the research teams; • Several measures support participation in bilateral agreements, ERA-nets, JTIs and FP7

5 Conclusions and open questions

Since January 1, 2007, when Romania became an EU member state, two main aspects have had an important influence on the shape and pace of R&D developments in Romania: the aim stated at policy level to integrate the Romanian Research Area (RRA) into the ERA and the need to satisfy specific EU demands. Among them, the political commitment to increase the GDP for public R&D expenditures to 1% by 2013 gave a strong impetus to resource mobilization.

5.1 Policy mix towards national R&D investment goals

Several strategic policy documents, acting as governance framework of the Romanian S&T policy have been formulated since 2007. All these policy documents emphasise the necessity of long-term investments in R&D and provide strategic orientation for the system and the frame for the R&D spending in the country. The current policy mix is broadly relevant to the national challenges in terms of pertinence and coherence, targeting the main drivers for private R&D. It can be assessed as a result of premeditated coordination of policy strategies offering overall a balanced support to the science base, knowledge inter-sectoral and international circulation and business innovation. The policy mix chosen in Romania contributes mostly to stimulating greater R&D investment in R&D performing firms, public-private collaboration and increase of R&D activities in public institutions. Several funding instruments, with budgets deriving from the SF and state budget are attached to these routes and are complemented by indirect measures such as tax incentives. The effectiveness of the new R&D is difficult to assess at this stage, as implementation of the National R&D Strategy for 2007-2013 is underway. Given the 2-3 years lag required by the business R&D expenditures to react after the public push, some positive policy impact should be visible starting 2012, if the implementation will follow the projected path.

The **main barriers to private R&D investments** faced by Romania are, as set out in Section 3: the low innovation culture and intensity of R&D expenditure; prevalence of traditional industrial sectors in economy and FDI; weak public administration; lack of awareness and transparency of public procurement; low business infrastructure; long term consequences of the chronic low RD investment. The main **policy risks** are related to the implementation process. Foremost, the lack of long term consistency can put under serious and definite risk, the whole RDI system. The 2009 significant R&D budget jeopardises the benefits of the prior developments, compromising the implementation of the R&D strategy. Although some steps have been made to address the persistent weak public administration, inefficient judiciary system and low access to public money, these remain important drawbacks. The design of ministries, agencies and policy mechanisms may make it difficult to implement the RDI policy effectively. The enterprises may remain reluctant to the public push that supports the increase of the competitiveness based on RDI activities. All these long-standing challenges are underlined by the very high uncertainty and volatility of all macro-economic national 2009 indicators, and weak budget programming mechanism.

5.2 ERA-related policies

Romania through its National Strategy for RDI clearly states its support to ERA. The European dimension and the importance of international/European co-operation and partnerships are highly acknowledged in the national R&D strategy.

The issue of 'rejuvenation' has been the focus of the new R&D human resources policy in Romania, yet the measures taken in isolation will bounce to no significant results. Some measures have been implemented to support mobility, scientific performance and to encourage inward mobility, nevertheless mainly from Romanian scientific Diaspora. Given the national context, the labour market for researchers remains unattractive for foreigners, many Romanian researchers choosing the more attractive options available abroad.

Measures have been implemented with the explicit aim to encourage/fund international R&D collaboration. Significant barriers to international opening are grounded in the national context, Romania having firstly to address the significant national drawbacks generated by the chronic underinvestment.

Universities are enjoying full freedom to manage their research budget, to autonomously design research agendas, having the right to own leadership. The state involvement aiming to create a viable HE environment does not limit at the "facilitative" role, but interfere by various means in the HE governance (i.e. staff recruitment and career advancement, governance of HEs are subject to governmental regulations). Nevertheless, while in the EU context this can be assessed as negative, the governmental involvement may be legitimate to some extent given the high number of newly established HEIs, among them many private institutions, and the derived problems (such as the alarming high degree of corruption).

In accordance with the recommendations included in the *Road map for the national RDI infrastructures*, the competition for the projects for large RIs was launched in 2008. Synergies with ESFRI were envisaged: in particular cases, due to the required high resources, it was considered more efficient to participate in ESFRI or available inter-governmental RIs.

ANNEX 1 Main National R&D actors

National R&D Institutes as ordered by Ad-Astra in terms of scientific output

1. National Institute of Nuclear Physics and Engineering Horia Hulubei (IFIN-HH)
2. National Institute for Materials Physics (INCDFM)
3. The Institute of Macromolecular Chemistry - Petru Poni (Romanian Academy)
4. National Institute of Physics of Lasers, Plasma and Radiation (INFLPR)
5. Institute of Physical Chemistry I.G. Murgulescu (Romanian Academy)
6. Institute of Mathematics Simion Stoilow (Romanian Academy)
7. Institute of Organic Chemistry Costin D. Nenițescu (Romanian Academy)
8. Institute for Electrical Engineering (ICPE-CA)
9. Institute of Chemistry C. Drăgulescu Timişoara (Romanian Academy)
10. National Institute of Technical Physics Iaşi

Main Public Universities (as ordered by Ad-Astra in terms of scientific output)

1. University of Bucharest
2. Politechnic University Bucharest
1. University Babeş-Bolyai Cluj
2. University Alexandru Ioan Cuza Iasi
3. Technical University Gheorghe Asachi
4. Universitatea of West
5. University Politehnics Timişoara
6. University of Craiova
7. Technical University Cluj-Napoca
8. University of Oradea

ANNEX 2: Other policies affecting the R&D investments

Development of business infrastructure and improvement of the business environment

- During the reporting period, the Romanian authorities have continued a series of actions and adopted new normative acts for the improvement of the regulatory framework that aims to facilitate the enterprises access /exit on/from the market. These actions were meant to reduce the waiting times, to simplify authorisation procedures and to support economic recovery of the entrepreneurs in case of financial difficulties. The 25 most burdensome procedures were identified as a

result of public consultations and should be eliminated in two stages: first stage – 12 procedures (April 2009); second stage – 13 procedures (deadline July 2009).

- The SME portal was created and launched in the third quarter of 2007.
- MEF implemented the JEREMIE initiative[69] on the general regulation of financial framework and creation of the Participation Fund JEREMIE in Romania.
- The "Programme for the development of entrepreneurial spirit among the women entrepreneurs",[70] and START Programme support the development of entrepreneurial skills of women, respectively young business people and facilitate their access to funding (NRP 2008).
- Six new business incubators were opened in 2007-2008 (NRP 2008).

Improving the participation rate of SME to public procurement contracts

The *"Working Group for Assessing the SMEs participation to the public procurement"* has been established with the aim to improve the SMEs participation to public procurement. For promoting the public procurement opportunities, the authorities have initiated on-line competition procedures on the portal www.e-licitatie.ro. In 2008, 118 training, information and publicity actions took place for supporting the potential beneficiaries to access the structural funds. The territorial offices network (OTIMMC) for SMEs information were developed to ensure the implementation of the national programmes financed from public funds, providing information and consultancy to local entrepreneurs regarding the available national and SF finances. Two support measures were promoted by NASR in order to facilitate firms' access to funding through SOP-IEC PA2. The Partnership Agreement with EXIMBANK provides financial support to public and private RDI organisations. Starting 2008, National Credit Guarantee Fund for SMEs (NCGFSME)[71] supports the development of SMEs sector in Romania by facilitating their access to financial instruments offered by commercial banks and other financing institutions[72] (NRP 2008). By the end of 2008, NCGFSME granted guarantees in value of RON350b (about €8.8m) to a number of 136 SMEs (National Agency for Small and Medium Sized Enterprises and Co-operatives).

ANNEX 3. R&D tax incentives

- VAT (value added tax) exemption for RDI activities performed under NPRDPI 2 programmes, and within the frame pf international, regional and bilateral partnership (Law 345/1 June 2002).
- Special tax regime for SMEs enabling them to pay either the corporate tax (a flat rate of 16 % applied to the company's profits) or a turnover tax of 2 % during 2007 (2.5 % during 2008 and 3 % during 2009).[73]
- Companies administering industrial parks (administrator companies) can benefit from the following incentives: (1) exemption from land-related taxes due on conversion of agricultural land to be used for industrial parks; (2) buildings,

[69] Cccording to the Law 154/2008
[70] 190 women were registered for participation into seminars for promoting successful business models, and 182 women for participation into entrepreneurial education courses
[71] In accordance with the Minister Order no 964/20.07.2008
[72] NCGFSME gives guarantees for maximum 75% of the value of a medium term and long term credit, 65% of the value of a short term credit, and 80% of the value of credits granted by banks to start-ups
[73] To qualify for this fiscal regime, the company must be a Romanian private legal entity, have between one and nine employees and a turnover of no more than €0.1m. In addition, the company's proportion of income derived from management and consultancy activities in the turnover should not exceed 50 %.

constructions and land located inside industrial parks are exempt from building tax and land tax; (3) other incentives which may be granted by the local authorities.

- Patents, licenses, know-how, manufacturers' brands, trademarks and service marks, as well as other similar industrial and commercial property rights, are depreciated during the contract period or during the period in which the purchaser intends to use the rights. Expenses for the production or purchase of software programmes are deductible on a straight-line basis over three years.
- Tax exception for all grants supporting any type of education or professional training in an institutionalised frame.
- Income tax exemption for the salaries of software creators provided that the IT activities are registered and that the software creators are highly educated in IT and hired as software engineers, system designers, system engineers or analysts.
- Companies organising training for up to 20% of total employees may be partially reimbursed for training expenses for maximum one training programme per year.

ANNEX 4. Romanian Participation in ERA-nets

FP6 ERA-NETs

AirTN, HY-CO, ERA-IB, EUROPOLAR, FORSOCIETY, MNT ERA-NET, COMPERA, ERA-AGE, IWRM.Net-CA, MANUNET, NEURON, SEE-ERA-NET, URBAN-NET

FP7 ERA-NETs

AirTN – FP 7, ASPERA-2, ERA-AGE Ext., ERACOBUILD, ERNEST, EUROCOURSE, EuroNanoMed, ICT-AGRI, iMERA-Plus, MNT-ERA.NET II, NET-HERITAGE, NuPNET, SEERA-EI

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List of Abbreviations

ARIES	Romanian Association for Electronic and Software Industry
ACPART	National Agency for Qualifications in Higher Education and Partnership between Universities and Socio-Economic Environment
ARACIS	Romanian Agency for Quality Assurance in Higher Education
ARIES	Romanian Association for Electronic and Software Industry
ASRO	Romanian Standards Association
BERD	R&D expenditure in the Business Enterprise sector
BSEC	Black Sea Economic Cooperation
CEEX	"Research of Excellence" Programme
CERN	European Organization for Nuclear Research
CF	Cohesion Funds
COST	European Cooperation in the field of Scientific and Technical Research
CREST	Committee for Research in Science and Technology
EC	European Commission
ECT	European Credit Transfer System
EIS	European Innovation Scoreboard
EPO	European Patent Office
ERA	European Research Area
ERA- MORE	The European Network of Mobility Centres
ESFRI	European Strategy Forum for Research Infrastructure
EU	European Union
EUFRU	Executive Unit for Financing Research in Universities
FDI	Foreign Direct Investment
FP	European Framework Programme for Research and Technology Development
GBAORD	Government budget appropriations or outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Expenditure on R&D
HEI	Higher Education Institutions
HRSTE	Human Resources in Science and Technology (Education) who successfully completed education at the third level in an S&T field of study
HRSTO	Human Resources in Science and Technology (Occupation)
ICT	Information and Communication Technology
IGL	Integrated Guidelines for Growth and Jobs
INSSE	National Institute of Statistics
IPR	Intellectual Property Rights
ITT	Innovation and Technology Transfer
JTI	Joint Technology Initiatives
MASRITT	Managerial Agency for Scientific Research, Innovation and Technology Transfer
MCIT	Ministry of Communications and Information Technology
MS	Member States
MEF	Ministry of Economy and Finance

MERI	Ministry of Education, Research and Innovation
MERY	Ministry for Education, Research and Youth
MNC	Multinational corporations
MS	Member States
NASMEC	National Agency for SMEs and Cooperatives
NASR	National Authority for Scientific Research
NCPM	National Centre for Programme Management
NCST	National Council for Science and Technology
NRP	National Reform Programme
NGO	Non-governmental Organisation
NCGFSME	National Credit Guarantee Fund for SMEs
NPRDI 2	National Plan for Research, Development and Innovation, 2007-2013
NRDIS	National Research, Development and Innovation Strategy
NSRF	National Strategic Reference Framework
NURC	National University Research Centre
OECD	Organisation for Economic Cooperation and Development
PA	Priority Axis
PRO	Public Research Organisations
R&D	Research and development
RCRI	Romanian Committee for Research Infrastructure
RDI	Research, Development and Innovation
ReNITT	The National Network for Innovation and Technology Transfer
Romob	Centres for mobility of researchers in Romania
ROSA	Romanian Space Agency
S&T	Science and Technology
SF	Structural Funds
SII	Summary Innovation Index
SME	Small and Medium Size Enterprise
SOIT	Romanian State Office for Inventions and Trademarks
SOP-HRD	Sectoral Operational Programme Human Resources Development
SOP-IEC	Sectoral Operational Programme: Increase of Economic Competitiveness
SOP ROP	Sectoral Operational Programme Regional Operational Programme
SWOT	Strengths, Weaknesses, Opportunities and Threats
VAT	Value Added Tax

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Abstract

The main objective of the ERAWATCH Policy Mix Country reports 2009 is to characterise and assess in a structured manner the evolution of the national policy mixes in the perspective of the Lisbon goals, with a particular focus on the national R&D investments targets and on the realisation and better governance of the European Research Area. The reports were produced for all EU Member State and six Associated States to support the mutual learning process and the monitoring of Member and Associated States' efforts by DG-RTD in the context of the Lisbon Strategy and the European Research Area. The country reports 2009 build and extend on the analysis provided by analytical country reports 2008 and on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

This report encompasses an analysis of the research system and policies in Romania.

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